PEST CONTROL

APRIL 1961

FLIES & MOSQUITOES

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Trap 75,000 Starlings . . . 52

Unusual *Pest Control* photo of two houseflies on saliva-coated toothpick.

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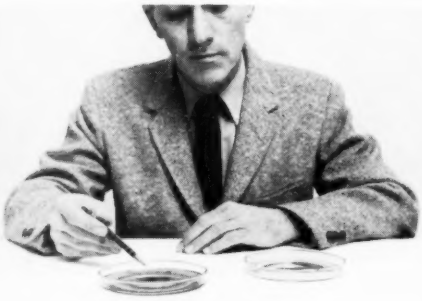

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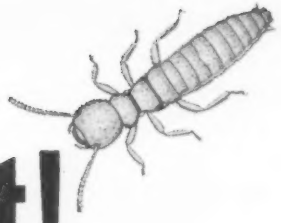
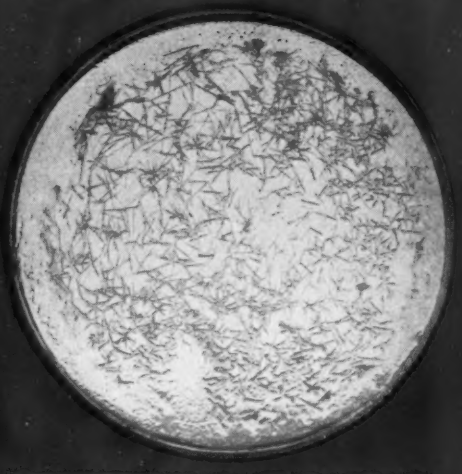


LOOK AT THE DIFFERENCE!

Chlordane, after the two week test period, remains a heavy, viscous liquid. It provides an unbroken barrier that no termite could penetrate.



The crystalline insecticide, after two weeks, has formed isolated islands of protection, separated by wide open spaces that termites could easily penetrate.

Now you can actually see one of the reasons why Chlordane provides longer residual termite control. This do-it-yourself termite barrier test shows that Chlordane always remains a sticky, viscous liquid. In the soil, it combines with every soil particle, to form an unbroken barrier. Crystalline insecticides react in a different way. They form hard, solid crystals, as soon as solvents evaporate. These crystals form isolated islands of insecticide, separated by big gaps that afford no protection.

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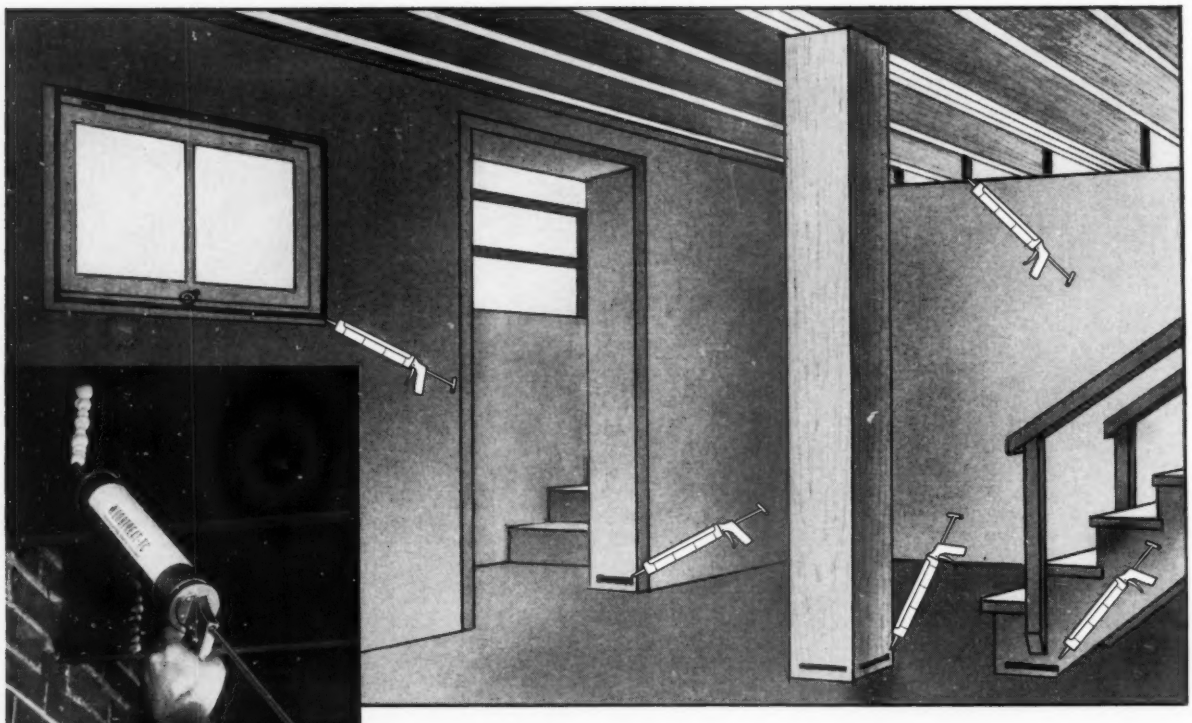

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PEST CONTROL

April, 1961 — No. 4 Volume 29

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420 Lexington Avenue
Phone: LExington 2-3667

Cooperating with
NATIONAL PEST CONTROL ASSOCIATION, Inc.

Published Monthly by
TRADE MAGAZINES, INC.
1900 Euclid Avenue
Cleveland 15, Ohio
Phone: PRospect 1-4169

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Contents of this issue © Trade Magazines, Inc., 1961

Single Copy Price: 75 cents; Foreign: $1.00. **Subscription Rates:** U. S. and possessions, 1 year $5.00; 2 years, $8.00. All other foreign subscriptions, 1 year $6.00; 2 years $10.00. **Change of Address:** Three weeks advance notice is necessary for change of address. Both old and new address must be given. Post Office will not forward copies. Second Class Postage paid at Cleveland, Ohio.

Competitive Bids and the F&DA

Recently Herman Fellton, president of Getz Exterminators, pointed to the fallacy of low-bid buying which dominates the way many food plants buy their pest control service. He said:

"Limiting factors in food plant work are not confined to the restrictions put on the chemicals PCOs may use, but more often the purchasing methods of the plants themselves limit what can be done.

"Contracting for pest control is frequently handled by a person in the food plant purchasing department who regards price the most important factor. In a recent case bids ranged from $35 offered by one PCO to over $200 bid by another. The purchasing agent automatically accepted the $35 bid. Thus *he* was in effect determining the amount of service the plant will receive.

"When the management of a food plant tells an FDA inspector that a PCO handles its pest control work, the statement may be true as far as it goes; in reality it could be untrue because the fee paid may enable only a very limited service to be given. F&DA agents should investigate the amount of service actually being purchased when violations are laid to faulty pest control methods."

Mr. Fellton might add that some PCOs are guilty of bidding low just to get food industry business. Many of them do not understand what all is involved. To do the job the way the food industry wants it done requires expenditures of large amounts of skilled time, and a considerable quantity of a variety of materials, which makes it expensive. So, to conform with the requirements of the F&DA, the food plant must pay, and the PCO must get, enough to cover the required amount of experienced time and the complex of chemicals that are necessary.

To achieve this realistic bit of economics is going to require the best cooperation from the food industry and the pest control industry, and the F&DA as well.

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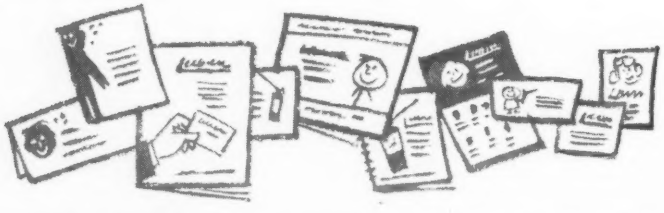

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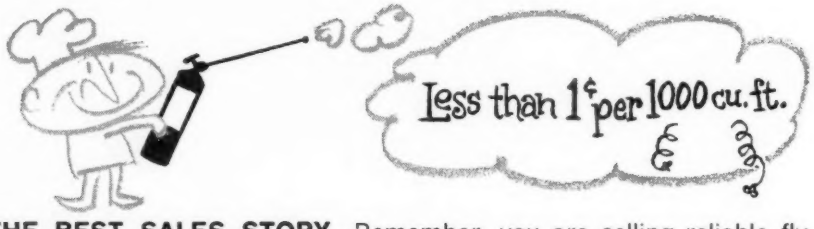

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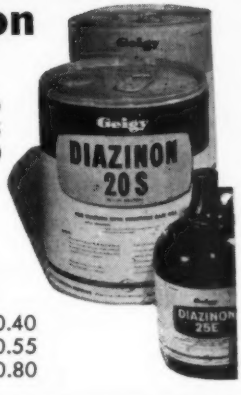

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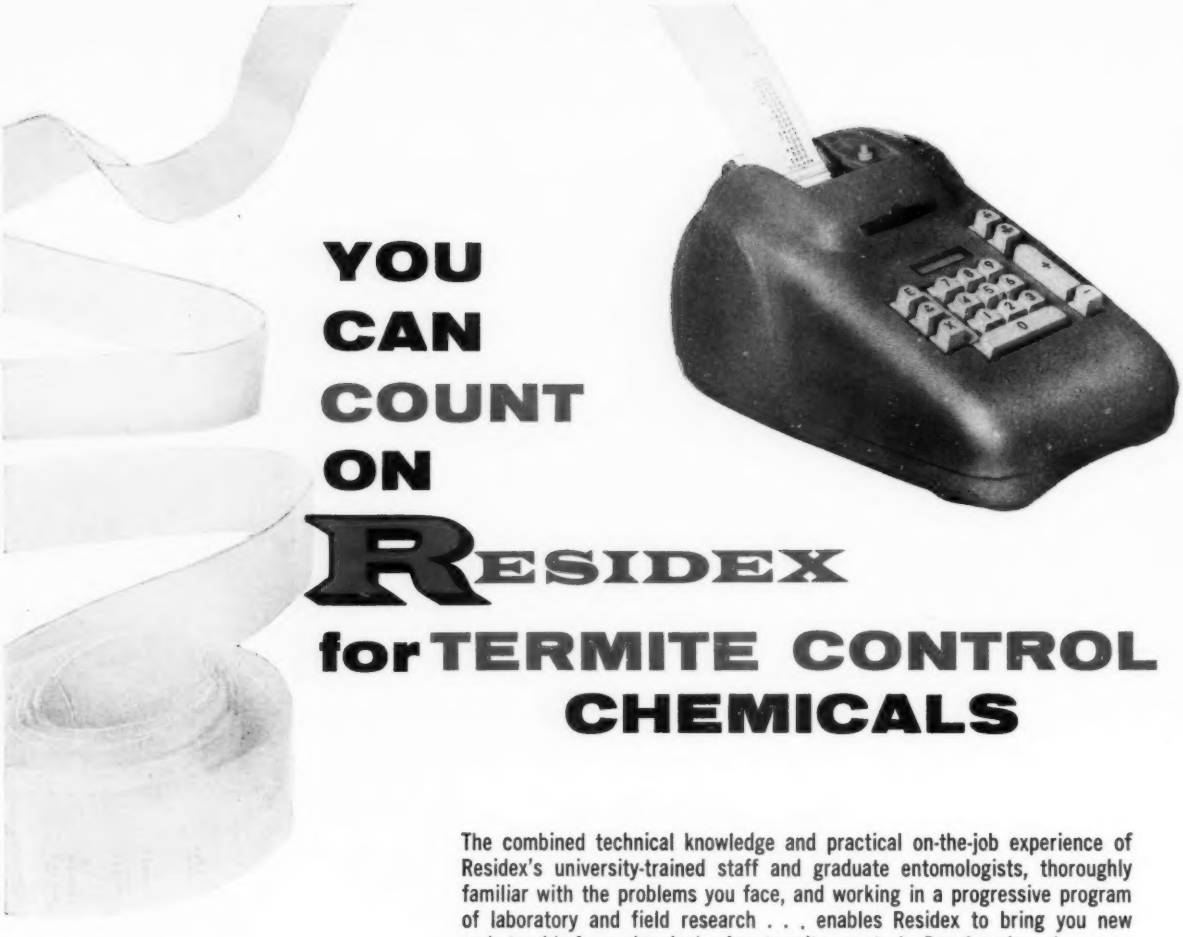

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Flies killed in one day by spreading 2 ounces of 0.25% Dibrom fly bait. Building was swarming with flies 24 hours before this picture was taken.

FLY BAITS

By
DR. D. E. HOWELL
Head, Department of Entomology
Oklahoma State University
Stillwater

FIFTY YEARS ago baits were considered one of the most useful methods of housefly control. During the summer months many homes had at least one saucer of fly bait in the kitchen. These baits were made by adding a poison such as formalin, sodium salicylate, arsenicals, or cobalt compounds to a mixture of sugar, milk, and water. Results were acceptable, but due to many cases of human and pet poisoning, fly baits became less popular. With the development of excellent chemical control their use was almost completely abandoned.

When insecticide resistance appeared in houseflies, new control procedures were essential and baits again became popular. They fill a need and can be used safely and successfully if the basic principles for their use are applied.

Placement Is Important

We know of no strong attractants that can be added to baits to draw houseflies from a distance, so it is important to place the baits where the flies will find them. This varies with the season and weather. During the warm summer months flies in search of food prefer the cooler areas near the floor or ground. With the return of cool weather, baits will be taken better if placed higher where it is warmer.

Formulation Is Important

Several types of bait formulations are needed for successful fly control. Housefly baits have been formulated with granulated sugar, ground grain (usually corn), flaky materials such as oyster shell or vermiculite, and in syrups. Each serves best in a particular place.

Sugar baits work best on relatively smooth, hard surfaces such as floors, sidewalks, window ledges, and similar areas. They are inconspicuous, easily spread, and easily formulated but must be used with care when the humidity is high or the surfaces are moist. They are easily blown about by the wind, may be quickly lost in breezeways or outside in windy regions or when broadcast on dust, straw, or gravel.

Baits formulated on ground corn are useful in barns or in areas around stores or warehouses where the rather obvious grain is not objectionable. They must be used with caution on unglazed tile window ledges or similar surfaces so that the oils from the grain will not be absorbed and spot the surface.

Oyster shell or vermiculite baits are useful in areas such as fair

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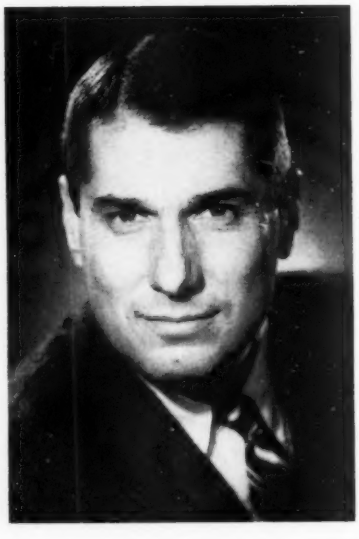
This Month's Money Maker

A Profitable Remedy For Mosquito, Fly and Gnat Pest Control Problems

by
HAL BUNTING
Sales Supervisor, Thompson-Hayward



If it crawls or flies, T-H offers an insecticide specifically designed to control it. Mosquitoes, flies, gnats and other small flying insects are easy prey for T-H products backed by quality chemicals and a competent technical staff. Check this list for the T-H insecticide to meet your needs:

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A new formula especially created for flies, mosquitoes and other flying insects. (Formulated for, and to be used only by Pest Control Operators.)

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Kills stable flies, house flies, fleas, mosquitoes, and roaches. (Contains D.D.T., 2 lbs. per gal.)

T-H Ded Tox 50W
A wettable powder designed for extra fast kill of flies, and other flying insects. (Contains D.D.T., 50%)

T-H Fogging Spray (Liquid)
For use with either Mechanical Foggers or smoke generators (Contains 10% D.D.T. — 5% Chlordane.)

Other T-H products available are:
T-H Malathion E-5 (Emulsifiable)
T-H Malathion 25W (Wettable Powder)
T-H Malathion Fly Bait
T-H Lindex WE-125 (Emulsifiable Lindane)
T-H Tri-6 50W (Wettable Powder B.H.C.)
T-H Diazinon Fly Bait

Thompson-Hayward formulates products for use in:
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Flying insects pose a continuing problem which requires immediate action. For the control of flies, gnats, mosquitoes, etc., inquire at your nearest T-H office for additional information.

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grounds, barns, and sales buildings where sugar or ground grain baits would quickly filter down through the straw or sawdust floor covering and be lost.

Syrup baits work well in the cooler parts of the year when they can be painted on walls or ceilings that will not stain and where fungi will not grow and cause dark staining.

Distribution

Widespread dispersal increases the opportunity for houseflies to find the bait and decreases the probability of children or animals being poisoned. Optimal amounts of sugar bait are one to two grains per square inch of surface. This provides an almost invisible layer which may be used effectively and safely in most areas. Bait stations may be needed in some situations, but they seldom provide a rapid control, and they are often unsightly and dangerous.

What Insecticide Is Best in Baits

The effectiveness of baits made with different insecticides may vary with the strain of flies, weather conditions, and the year; but, in general, data collected in one area apply to other regions.

During 1960 an extensive series of comparisons was carried out to determine the most effective fly baits. Two percent sugar baits were mixed with each of the promising or widely used insecticides. These were tested by uniformly scattering two grams of a bait on an 8 inch square of paper. These papers were randomly arranged on the floor of a large hog barn where flies were very numerous. Each bait was replicated 12 times and the entire series was run each week during the fly season.

Each 15 minutes the dead flies found on the papers were counted and left in place. If the papers became so covered with the flies that live flies were unable to find the bait, the paper was cleared, 2 more grams of bait added, 20 dead flies placed on the paper for decoys, and counting continued.

Dibrom[1] and DDVP (Vapona)[2] were almost equally effective. They killed more than twice as many flies as the next insecticide, Dylox[3]. Malathion[4] and Korlan[5] were almost as effective as Dylox, followed closely by Diazinon[6], Chlor-

thion[7], and Kepone[8]. The last material killed rather slowly and under the conditions of the test may not have appeared as effective as it actually was. The three most effective materials, Dibrom, DDVP, and Dylox were further tested by formulating baits containing 1.0, 0.5, 0.25, 0.1, and 0.05%.

To our surprise the most effective concentration of DDVP and Dibrom was 0.05%, followed closely by 0.1 and 0.25%. Within a week, however, 0.05 baits were relatively ineffective and 0.1% formulations were the most effective. Within three weeks these baits had lost much of their killing power and 0.25% baits were the most effective. When baits were carefully stored under dry conditions, 0.25 or 0.5% baits were most effective during the rest of the season.

Storage

Baits left in open containers absorbed moisture from the air and deteriorated rapidly, particularly those made of Dibrom, but the baits containing larger quantities of the other insecticides also deteriorated. Unless stabilizing materials are added, baits should not be mixed in larger quantities than will be used during a fly season, as the shelf-life of the baits used in these experiments was short.

Warning Colors

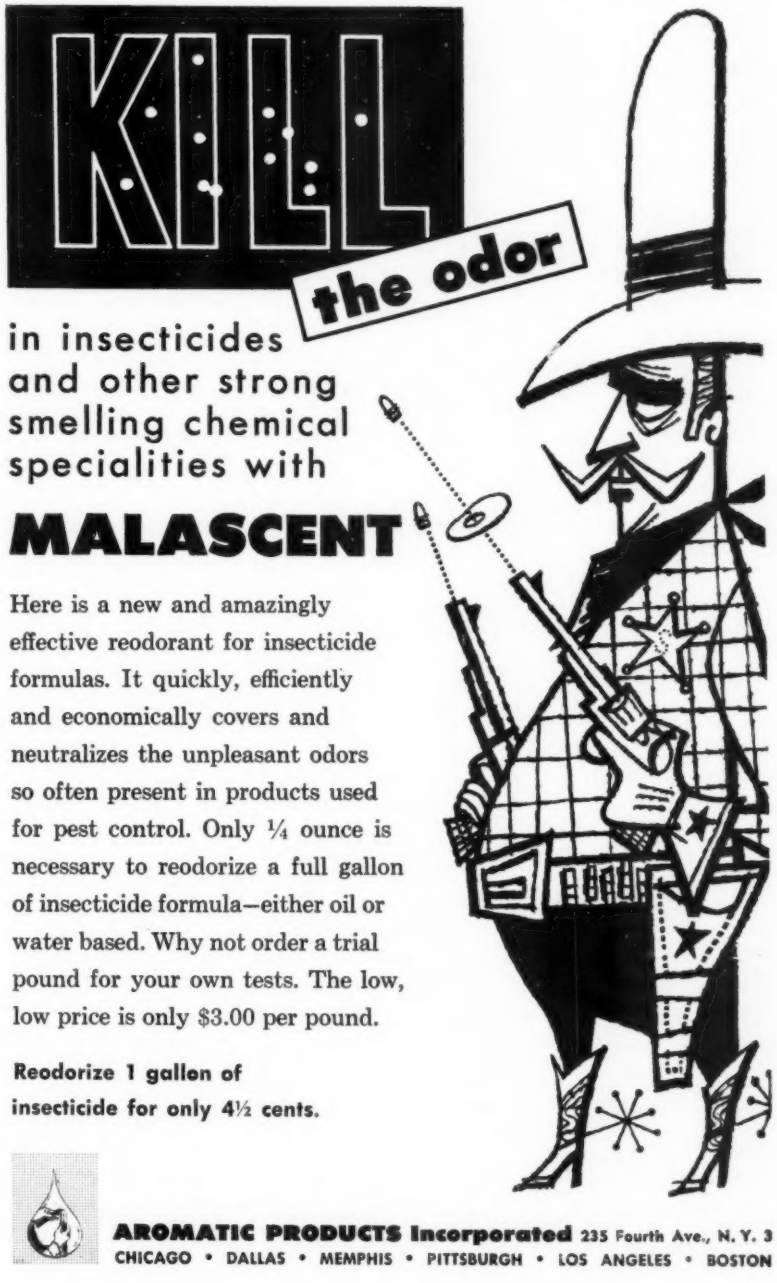
Sugar or cracked grain baits may create a hazard due to accidental use. To avoid this, many commercial formulators add a warning color. The effects of color on the acceptability of the bait were determined by adding a wide range of colored dusts to baits of the same composition and comparing the number of flies killed.

Tan baits killed the most flies, followed by yellow, brown, and pink. These were more attractive than uncolored baits. Black, dark blue, red, and deep orange were the least attractive and reduced the effectiveness of the baits as much as 50%. Dyes dissolved in acetone were used to color baits and similar results were obtained indicating that the powdered colors were effective as colors, not because of their physical or chemical composition.

Fly baits provide excellent control of houseflies, but cannot be expected to work against stableflies or most blow flies. In many cases, both sugar baits and cracked corn or cracked peanut baits successfully controlled roaches. Dylox baits were the most effective, but the others were useful aids. Snails and slugs were also reduced in number.

In summary, housefly baits are a very useful tool for fly control. The most effective insecticides in the Stillwater tests were Dibrom and DDVP, and baits containing 0.25 to 0.5% of the insecticide were most effective. The choice of carrier is determined by the way in which the baits will be used.

1. 1,2-dibromo-2,2-dichloroethyl
2. 0,0-dimethyl 2,2-dichlorovinyl phosphate
3. dimethyl (2,2,2-trichloro-1-hydroxyethyl) phosphonate
4. 0,0-dimethyl dithiophosphate of diethyl mercaptosuccinate
5. 0,0-dimethyl 0-2,4,5-tri-chlorophenyl phosphorothioate
6. 0,0-diethyl 0-(2-isopropyl-6-methyl-4-pyrimidyl) thiophosphate
7. 0,0-dimethyl 0-(3-chloro-4-nitrophenyl) thiophosphate
8. decachlorooctahydro-1,3,4-metheno-2H-cyclobuta/cd/pentalen-2-one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Day In Day Out Periodic Aerosoling

by

ALBERT EDELSTEIN, President, Syncro-Mist Controls, Inc., New York, New York

AN ENTIRELY new technique for the application of aerosol insecticides has been made possible by a recent technical advance that permits *controlled, periodic, metered-dose dispensing* of insecticides to provide round the clock, unattended control of flying insects.

Prior to World War II, the method of dispensing air-borne insecticides was by use of hand sprayers, pump-up equipment and electric or air powered sprayers. In these forms of applicators, either liquid oil sprays, or emulsifiable sprays were used in the order of ½ to 2 ounces of liquid per 1000 cubic feet, depending on the strength of the formula.

In the post-war era, a new concept was introduced, the pressurized insecticide dispenser, commonly known as an insect bomb. This provided ease of operation and, because of the efficient aerosol particles produced, permitted higher concentrations of active material in a formulation which resulted in dispensing less solvents, reducing the volume of formulation dispensed to an average of 3 grams per 1000 cubic feet. This was a great stride forward, although also restricted to use over short periods of time, and therefore having limited effectiveness.[1]

In the early 1950's a thermal vaporizer insecticide device was sold by the thousands. This unit was automatic but not *periodic.* Because of this limitation and the immunity of insects to the chemical it contained, the use of this product was restricted in many parts of the country and prohibited in others.

There was a need in the aerosol field for an automatic and periodic device as an adjunct to a pressurized container, which would permit use of aerosols in commercial and industrial applications where dispensing of products on a precision basis could be an advantage over methods in use at that time. There was also a need for improved formulations of insecticides, specifically adapted for use with such a device. In 1958, after a five year comprehensive, scientific study of all phases of pressurized aerosol products and dispensers, and of the related physical, chemical, physiological and other problems, we developed such an automatic, periodic, metered-dose, actuating device to dispense insecticides for an unattended period of 34 days.

As a result of some 50 or more individual biological studies, using the common housefly as the subject, it was indicated that with a highly concentrated aerosol formulation, dispensed in very small doses, at regular and definite intervals, large regions of space could be effectively treated, aerosol concentration levels maintained, and air-borne insects controlled on a continuing basis.[2]

The biological studies submitted to the United States Department of Agriculture resulted in an approval label with the following formula.

Pyrethrins	.9%
Piperonyl Butoxide	9.0%
Petroleum Distillate	10.1%
Inert Propellants	80.0%
	100.0%

With a metering device in the container, a measured dose of 100 mg. is dispensed each 15 minutes and is effective for an area of 6000 cubic feet, equivalent to a room 20′ x 30′ x 10′.

Food, drug and sanitation officials, are more concerned with the potential human hazard involved in this new method of insecticide application, and its possible entry into the body via ingestion, inhalation or dermal routes.

As the label indicates, the safest of insecticides have been selected, pyrethrins and piperonyl butoxide, and they are dispensed into the atmosphere in the least possible volume.[3]

These chemicals have a high order of safety to warm-blooded animals, whether judged by an index of irritation, by oral administration, or by sub-acute or chronic feeding tests. Pyrethrins are so rapidly metabolized by the body, that an animal can tolerate each day in its food, a greater amount than that normally required for an acute oral LD 50. Moreover, 80 to 90% of the piperonyl butoxide passes through the intestinal tract unchanged, which means that it is poorly absorbed by the body.[4, 5, 6]

What is the toxicity of the formula to higher animals? It can be used with safety (with pyrethrum or pyrethrins) on stored grains, cereal bags, in homes and on animals where more hazardous materials cannot be used. It is practically non-toxic and non-irritating to mammals or birds; non-carcinogenic: 42 p.p.m. in the total diet is considered a safe human concentration. Dermal absorption is poor.[6]

Threshold limits should be used as guides in the control of health hazards and should not be regarded as fine lines between safe and dangerous concentration.[7]

Threshold limit for pyrethrum is 2 mg. per Cu. M.[7]

On the basis of 35.3 cubic feet to a cubic meter, in an area of 6000 cubic feet, the effective area of an automatic unit, the threshold limit would indicate a continuous permissible level of 340 mg. of pyrethrum. The emitted quantity of pyrethrum each 15 minutes from a Syncro-Mist Actuator is .9 mg.

The following figures were developed to indicate the possible deposit of pyrethrins and piperonyl butoxide when used with the Syncro-Mist Actuator, based on

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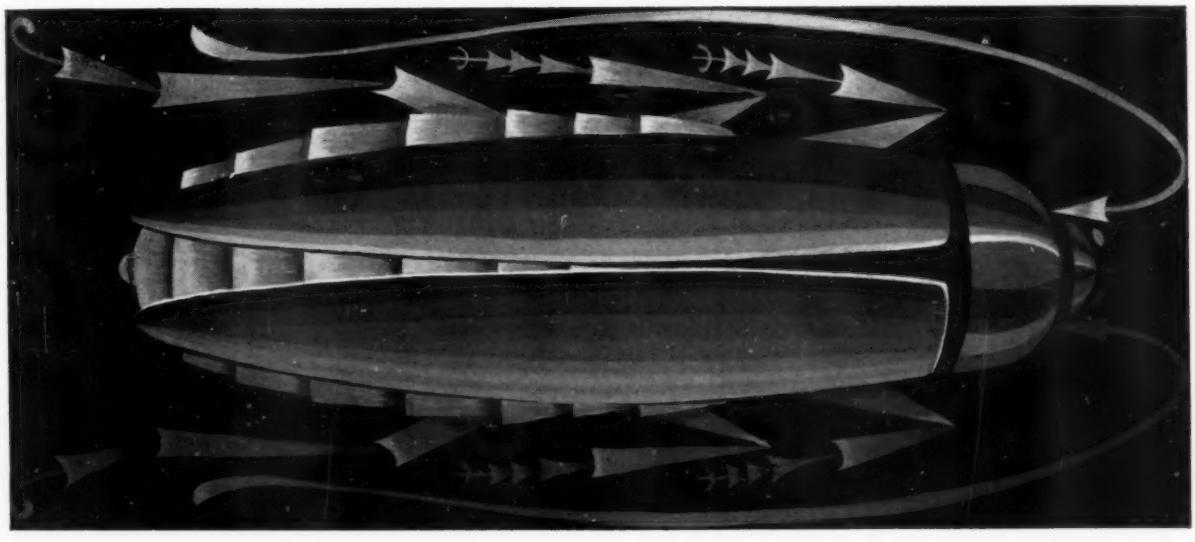

Korlan® 24E insecticide knocks out resistant strains . . . non-resistant strains, too . . . of roaches, flies and bedbugs—most kinds, in fact. And Korlan 24E kills where it's been sprayed for as long as six weeks!

Less toxic than any organic phosphate with equal residual action, Korlan 24E is safe for use in kitchens, and food and meat plants. There's no staining of walls or lingering odor, either, to tell you've been there. Only the absence of live insects tells that!

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Korlan 24E insecticide is stable. Pre-mix it in oil and store for future use. It's completely soluble in deodorized kerosene and common base oils, and emulsifiable in water.

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When used as directed on label and in accordance with good practices, complies with the Food and Drug Law and other Federal Laws.

THE DOW CHEMICAL COMPANY DOW Midland, Michigan

an aerosol fill of 80% propellant and 20% insecticide and solvent.

Total dose of 9.6 grams dispensed in 24 hours in 6000 cu. ft. at rate of 100 mg. each 15 minutes:

Propellant	7.6800 grams
Pyrethrins	0.0864 grams
Piperonyl Butoxide	0.8640 grams
Petroleum Distillate	0.9696 grams
	9.6000 grams

When this material is dispensed in an area of 6000 cubic feet, representing an average size room of 20′ x 30′ x 10′, and assuming no dispensed material escapes, or is deposited on walls or ceiling, which would *reduce* the deposit, the amount of fallout on one square foot of surface would be as follows, when all the emitted material drops vertically:

Pyrethrins	0.000144 grams
Piperonyl Butoxide	0.001440 grams
Petroleum Distillate	0.001616 grams

Assuming further this material deposits on a one-inch thick material, (sp. gr. of 1.0) occupying the one square foot area, thus simulating a subject of exposed food for 24 hours, the following would result:

Pyrethrins	0.06 p.p.m.
Piperonyl Butoxide	0.60 p.p.m.
Petroleum Distillate	0.67 p.p.m.

These quantities are not measurable.

Both pyrethrins and piperonyl butoxide are exempt from requirement of a tolerance, when applied to growing crops, in accordance with good agricultural practice.[8]

In apples and pears, blueberries, huckleberries, cherries, oranges, and other commodities, post harvest use of piperonyl butoxide tolerance has been set at 8 p.p.m. and pyrethrins at 1 p.p.m.

On February 27, 1960 in the Federal Register, pages 1727 and 1728, the Food & Drug Administration defined its position with respect to pyrethrins and piperonyl butoxide as an indirect additive to be incorporated in the food.

It indicates that no limit has been set at this time, in view of the safety of these ingredients.

This new and regulated method of continuous flying insect control, provides a practical pest control tool.

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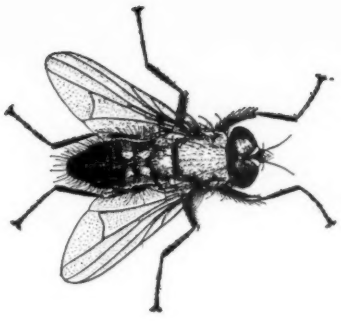

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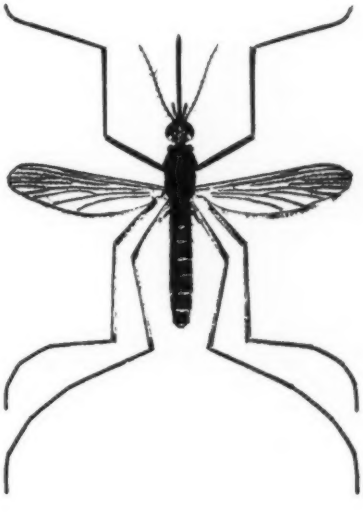

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4. Clean clogged roof gutters; drain flat roofs so no water stays.

5. Cover all standing receptacles with water-proof netting.

6. Empty and refill outdoor bird baths daily.

7. Stock garden pools with goldfish.

8. Tilt wheelbarrows, etc. with containers, to prevent holding water.

9. Be sure screens fit tightly; that all doors open out.

10. Dispose of old tires or anything which holds water.

drawings from a bulletin of the
Ocean County Mosquito Extermination Commission
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Aquatic Weeds Cost Govt. $25 Million Yearly, Meet Hears

Annual meeting of the Aquatic Weed Control Society, held in the LaSalle Hotel, Chicago, Ill., February 14th and 15th, 1961, drew over 100 applicators, scientists, and regulatory delegates from 21 states and Canada who met to share current technical information on chemical aquatic weed control and application procedures.

Keynote speaker was Dr. W. B. Ennis, Jr., Chief, Crops Protection Research Branch, U.S.D.A., Beltsville, Maryland. Dr. Ennis pointed out that the cost of weed problems in irrigation systems built by the Bureau of Reclamation amounted to a financial loss of nearly three million dollars annually. Projecting these figures to all irrigation systems in 17 western states, he estimated a 25 million dollar annual loss due to aquatic weeds.

A panel discussion on the merits of chemical compounds now being tested and marketed for possible aquatic weed herbicides was presented by representatives of the chemical industry. Panel members were Harrold B. Jones, American Smelting and Refining Company; Cecil Kerr, Chipman Chemical Company; Mark Wiltse, Dow Chemical Company; James Flanagan, Geigy Chemical Company; Charles Bolster, Pennsalt Chemical Co.; and Lyle Hill, Reasor-Hill Chemical Company. The necessity to develop chemicals which will control the nuisance, be nontoxic to humans and aquatic life, and be economically feasible was theme of the discussion.

James W. Smith, field landscape architect of the Metropolitan-Huron-Clinton Authority of Detroit, moderated a panel on application procedures and equipment. It was brought out that even though an ideal herbicide is available, its peak efficiency can only be obtained through the use of proper equipment and application methods. Members of this panel were: Al Lopinot, Illinois Conservation Dept.; Paul W. Eller, Chipman Chemical Co.; John Gallagher, Amchem Products, Inc. William C. Hall, Arboreal As-

(*Continued on page 56*)

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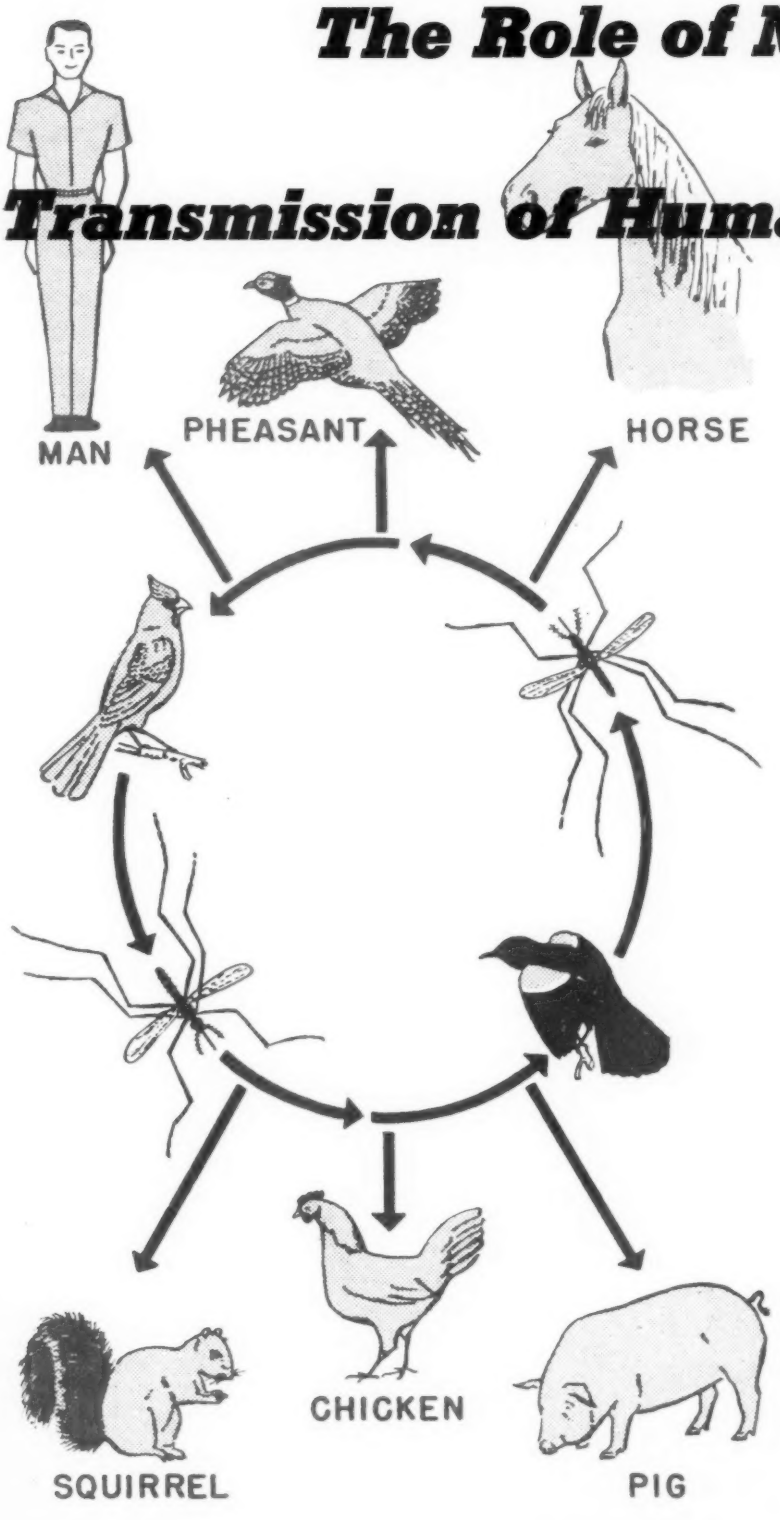
The Role of Mosquitoes in the Transmission of Human Disease

by

BAYARD F. BJORNSON

Assistant Chief, Insect & Rodent Control Training,
Communicable Disease Center
Public Health Service
U. S. Department of Health, Education & Welfare
Atlanta, Georgia



Summer Infection Cycle of Encephalitis Virus

MOSQUITO-BORNE diseases have been an extremely important factor in world history. Malaria has killed millions of human beings and has caused sickness in untold millions more. Frightful epidemics of this disease wreaked havoc on Rome in the later periods of the Roman Empire. Malaria and yellow fever were formidable obstacles to the Panama Canal development until Gorgas and LePrince's remarkable work controlled them at the start of this twentieth century. Malaria is still the most important arthropod-borne disease in the world. Today mosquito-borne diseases threaten and plague us, though at a greatly reduced rate. A recent outbreak of eastern encephalitis in New Jersey and explosive outbreaks of the encephalitides throughout the United States in recent years have made them the most important arthropod-borne diseases in this country today. We need to know much more about them before we can devise efficient control measures. In this paper, the major emphasis is placed on the encephalitides.

Malaria

Malaria is an acute or chronic disease caused by tiny protozoan parasites of the genus *Plasmodium*, which are transmitted from man to man by *Anopheles* mosquitoes. In the United States there are 15

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2. Can be applied by airplane any time of day during normal weather conditions; also may be applied by hand operated spreaders, or by power dust blowers.
3. Virtually non-hazardous to humans, fish, wildlife and beneficial insects, when used as directed.
4. Mosquitoes have shown no indication of resistance to Air-Flo Green or Paris green.
5. Most of the granules float, but some sink. Consequently, the toxicant is released throughout the surface and depth of the water, to be swallowed by all larval stages.
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species of *Anopheles*, but only two species seem to be important in transmission of this disease, *Anopheles quadrimaculatus*, east of the Rockies, and *Anopheles freeborni*, west of the Rockies.

Malaria is prevalent between latitude 45°N. and 40°S. around the world and is responsible for more deaths per year than any other arthropod-transmitted disease. It has interfered with the development of the tropics and has probably had a more profound influence on world history than any other disease.

The number of malaria cases has declined by tens of millions in the past few years under the impact of modern residual insecticides applied on a nation-wide scale in many countries. Yet, as recently as 1957, close to 200,000,000 clinical malaria cases occurred in the world with *two million* deaths (Russell, 1958). Ceylon is a good example of the effectiveness of a successful nation-wide residual spray program. There, morbidity rates have fallen from a 1940 level of 574 per 1000 population to a low of 0.35 per 1000 in 1956. Malaria has been similarly reduced in the Western Hemisphere, and in many other countries such as Italy, India, and the Philippines.

For many years malaria was the most important insect-borne disease in the United States with estimates of several million cases in epidemic years. The majority of these cases occurred in the eastern, midwestern, and particularly the southern states. In the early 1930's, over 100,000 cases were officially reported to the U.S. Public Health Service. By 1942, this number had dropped to about 60,000. In 1946, the Communicable Disease Center began the National Malaria Eradication Program in cooperation with state health departments. In 1948, 1,365,000 houses were sprayed with a DDT residual spray. World War II and the Korean War caused a rise in malaria incidence in the United States largely due to cases in returning veterans. Since 1952, the number of cases has decreased rapidly. Provisional data for 1958 and 1959 indicate that there were less than 100 cases of malaria officially recognized in all the United States, almost all of them relapses in people who had been outside this country. In 1958 only 3 cases, and in 1959 only a single case, of malaria were contracted by people who probably had not been outside the United States.

Yellow Fever

Yellow fever is a virus disease with two distinct epidemiological types: urban and jungle yellow fever. Both are caused by the same virus, and people may be protected from both types by the same vaccine, but the insect vectors and vertebrate hosts are quite different.

Classical urban yellow fever, transmitted by *Aedes aegypti*, with the cycle (man-yellow fever mosquito-man) has largely disappeared. Jungle yellow fever, on the other hand, with a normal cycle monkey-to wild mosquitoes (*Haemagogus, Sabethes*, etc.)-to monkey is endemic in South America. Man gets the disease by accident when bitten by these wild mosquitoes in their natural habitat, the jungle.

The last epidemic of yellow fever in the United States occurred in New Orleans in 1905, and the last death was in a Mexican immigrant reported to have died in Houston, Texas on October 8, 1924 (Hughes and Porter, 1959). Beginning in 1948 a wave of jungle yellow fever began sweeping north from Panama through Central America (Soper, 1958) reaching the various countries as listed below:

Panama	1948	Honduras	1953
Costa Rica	1951	Guatemala	1955
Nicaragua	1952	Trinidad	1954-'59

In 1954, 13 cases of jungle yellow fever and 2 cases of urban yellow fever were reported in Trinidad, leading to the closing of Port-au-Spain and increased surveillance and quarantine measures, particularly at international airports. In January 1959 two cases of jungle yellow fever occurred in a remote jungle area near Biche in southeastern Trinidad, B.W.I.

A. aegypti are still found in many areas of the southeastern United States, though they have apparently disappeared from some cities. However, there is a continuing need for yellow fever vaccinations of persons who travel into yellow fever areas, for medical examinations of persons and monkeys coming from these areas, for disinsectization of aircraft and

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Fogging by pest control operators in community mosquito control programs can help quell the spread of encephalitis and other mosquito-borne diseases. Here a PCO fogs trees and yards of a typical suburban street during a recent control project in the eastern section of the country.

ships, and for entomological surveillance of airports and dock areas.

Dengue

Dengue, also called breakbone fever, is an acute, rarely fatal disease caused by a *virus*. It is characterized by sudden onset, high fever, severe headache, backache, and joint pain, and a rash appearing on the third or fourth day, particularly on the hands and feet. Its mortality rate is very low.

Dengue is transmitted from person to person by *Aedes aegypti*, the yellow fever mosquito. The cycle is similar to that in yellow fever. It may occur in explosive epidemic form in almost any part of the tropics or subtropics. It has been prevalent in the Mediterranean, Africa, South America, Southeast Asia, and the Pacific Islands. The U. S. Public Health Service has been concerned with four outbreaks in the past 35 years as follows:

1922 — Florida to Texas perhaps 2 million cases (estimated 1 million cases in Texas alone)

1934 — Florida to Georgia — estimated 15,000 cases

1943 — Hawaii — estimated 1400 cases

1945 — Louisiana — several hundred cases

Dengue is not known to occur in California.

Filariasis

Human cases of filariasis are caused by two nematode worms, *Wuchereria bancrofti* and *malayi*, hence the names Bancroftian or Malayan filariasis. The adult worms live in various parts of the lymphatic system. Young filarial worms are transmitted from person to person by various species of mosquitoes including *Culex pipiens-quinquefasciatus* complex, *Aedes polynesiensis*, and *Anopheles gambiae*, and certain species of *Mansonia*. Symptoms range from inapparent infections to inflammation and other complications. In some people who have prolonged and repeated infections, there may be extreme enlargement of parts of the body, often with thickened and rough skin called elephantiasis (clinical term). It is widely distributed in tropical and subtropical regions, and is found in the West Indies, Columbia, Venezuela, Panama, and coastal portions of the Guianas and Brazil in the Western Hemisphere.

During World War II, it was feared filariasis might become established in the United States when 10,000 of 38,000 Marine and Navy men became infected (Coggeshall, 1946). In fact, at one time 2,600 of these men were located at Klamath Falls, Oregon. In these men (4 years later), not a single case of elephantiasis developed. Napier believed filarial worms only develop in mosquitoes when the mean temperature is 80°F. and the relative humidity 60%. If true, only states bordering the Gulf of Mexico, Georgia and South Carolina, would be favorable for establishment of filariasis. A small endemic center existed for many years near Charleston, South Carolina, but this has disappeared. This disease is not now known to be naturally acquired in the United States.

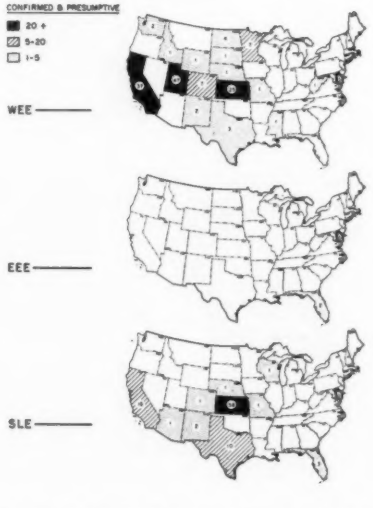
Encephalitis

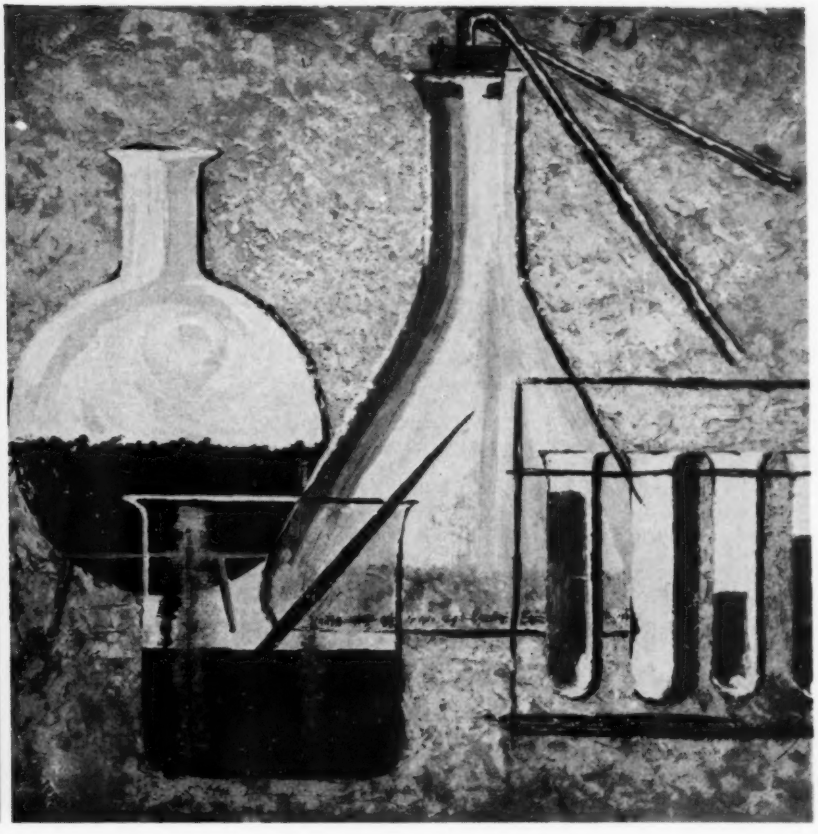
Several virus diseases which affect the central nervous system of man and cause encephalitis, an inflammation of the brain, are transmitted by mosquitoes. These viruses were first isolated in the 1930's, but there is good evidence that outbreaks occurred in horses over 100 years ago. In the United States, eastern encephalitis, western encephalitis, and St. Louis encephalitis are the most important of these viruses. The first two occur in horses and mules as well as man, but the St. Louis type affects man without noticeable effect on horses. Severe outbreaks of eastern and western encephalitis have occurred in horses and man during the past 25 years.

Present knowledge indicates that birds serve as natural hosts and reservoirs, mosquitoes as principal vectors of the encephalitides, and that the only way man becomes infected is by the bite of an infected mosquito. Human cases vary from mild, inapparent infections to very severe illnesses with permanent damage to the brain and other parts of the nervous system or even death. Identical symptoms occur in horses. Infections in birds are apt to be mild, with the exception of eastern encephalitis which frequently kills captive pheasants.

Symptoms of severe infections

GEOGRAPHIC DISTRIBUTION OF HUMAN ARTHROPOD-BORNE ENCEPHALITIDES — 1958





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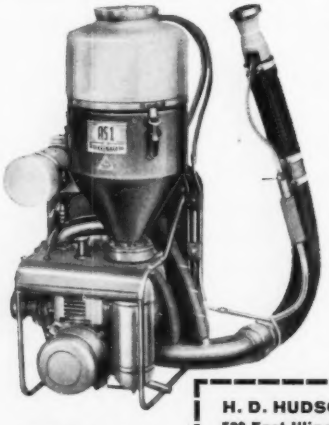

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include abrupt onset, high fever, severe headache, stiff neck, irritability, drowsiness and coma, muscular twiching and convulsions. These symptoms are sometimes mistaken for poliomyelitis. Residual paralysis is not common in encephalitis.

Hess and Holden (1958) feel that the basic transmission is from bird to bird by mosquitoes. They consider human and horse cases as accidents and deadend hosts in the chain of infection. Studies by Kissling and co-workers (1954) indicate that small birds such as the English sparrow, grackle, or red winged blackbird develop a high level of virus viremia for a few days, during which mosquitoes can become infected. Virus levels are usually lower in man, larger birds, and horses, thus reducing the likelihood of mosquito infection from these larger birds and animals.

Maintenance of Viruses

No satisfactory explanation as to how the encephalitis virus passes the winter has been proved, but two theories are now being investigated:

1. The virus overwinters in migratory birds and moves north each spring in these birds.
2. The virus overwinters in resident birds or hibernating mosquitoes and "spills over" into the nestling bird population each spring.

Recent studies of Kissling and co-workers indicate the second theory is the more probable (Beadle, 1959).

These mosquito-borne viral encephalitides are the most important vector-borne diseases in the United States today. Two reasons for their importance are:

1. They can cause alarming serious illness, permanent impairment, and sometimes death.
2. They are widely distributed in this country.

Viral encephalitides are not only a threat to rural areas, but also to large population centers located nearby. Since 1933, more than 20 outbreaks have occurred in the United States without advance warning (Donaldson, 1958).

Water resources development has expanded rapidly in recent years, particularly in the field of irrigation. This has been especially true in the western states where

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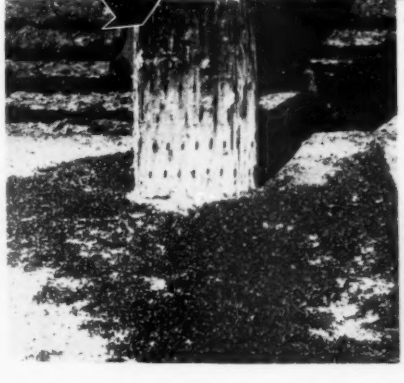


the total acreage of irrigated land increased from 17 million in 1939 to almost 30 million acres in 1956 (Rainey and Hess, 1957). In California alone, a doubling of the present 8,000,000 acres of irrigated land is expected in the near future with a corresponding increase in the potential of the mosquito problem, particularly *Culex tarsalis*, the common vector of encephalitis in the far West (Merrill, 1957).

Eastern Encephalitis

Eastern encephalitis is found along the Atlantic and Gulf Coasts and in limited areas of the Mississippi Valley. According to Chamberlain (1958) "the foci of eastern encephalitis infection are fresh water swamps."

Notable outbreaks have occurred in recent years:

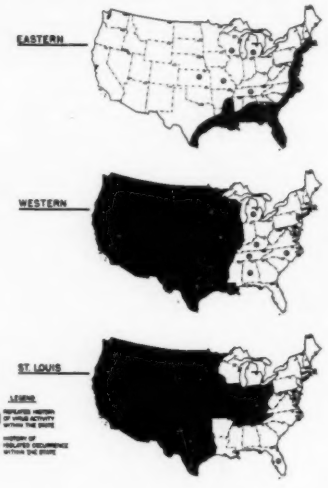
Year	*Location*	*Cases*	*Deaths*
1938	Massachusetts (Near Hockomack Swamp)	34	25
1947	Louisiana	10	9[1]
1956	Massachusetts	12	8
1959	New Jersey	33	21[2]

1. Rivers, 1959 2. Kandle, 1960

Eastern encephalitis occurs in horses and pheasants very commonly. In the 1947 Louisiana outbreak, 14,334 horse cases with 11,722 deaths occurred. Since 1938, over 100 outbreaks have been reported in pheasant flocks. Domestic fowl are not considered important reservoirs of this disease. The mortality rate for eastern encephalitis is high, averaging 60% in humans and 90% in horses.

GEOGRAPHICAL DISTRIBUTION OF ARTHROPOD-BORNE ENCEPHALITIDES IN THE UNITED STATES

(Total Virus Activity in Man and Animals)



Culiseta melanura, the bog mosquito, is considered the primary vector for maintaining the disease cycle of eastern encephalitis in nature (bird-mosquito-bird), but has not been proved responsible for human and horse outbreaks. Certain other genera of mosquitoes such as *Aedes*, *Mansonia*, and *Psorophora* are suspected vectors. This virus has been isolated from over 20 species of birds.

In general, the distribution of eastern encephalitis cases corresponds with the location of favorable *C. melanura* breeding sites, namely, major fresh water swamps in the low-lying coastal plains. Abundant rainfall appears conducive to eastern encephalitis outbreaks, and prevailing dry conditions tend to inhibit them. A small outbreak of eastern encephalitis in humans occurred in Massachusetts in 1956. Though this disease was widespread in horses and pheasants all along the Atlantic and Gulf Coasts from Massachusetts to Louisiana, only 3 other human cases were reported, 2 from Maryland and 1 from Delaware.

Recently New Jersey had an outbreak of eastern encephalitis

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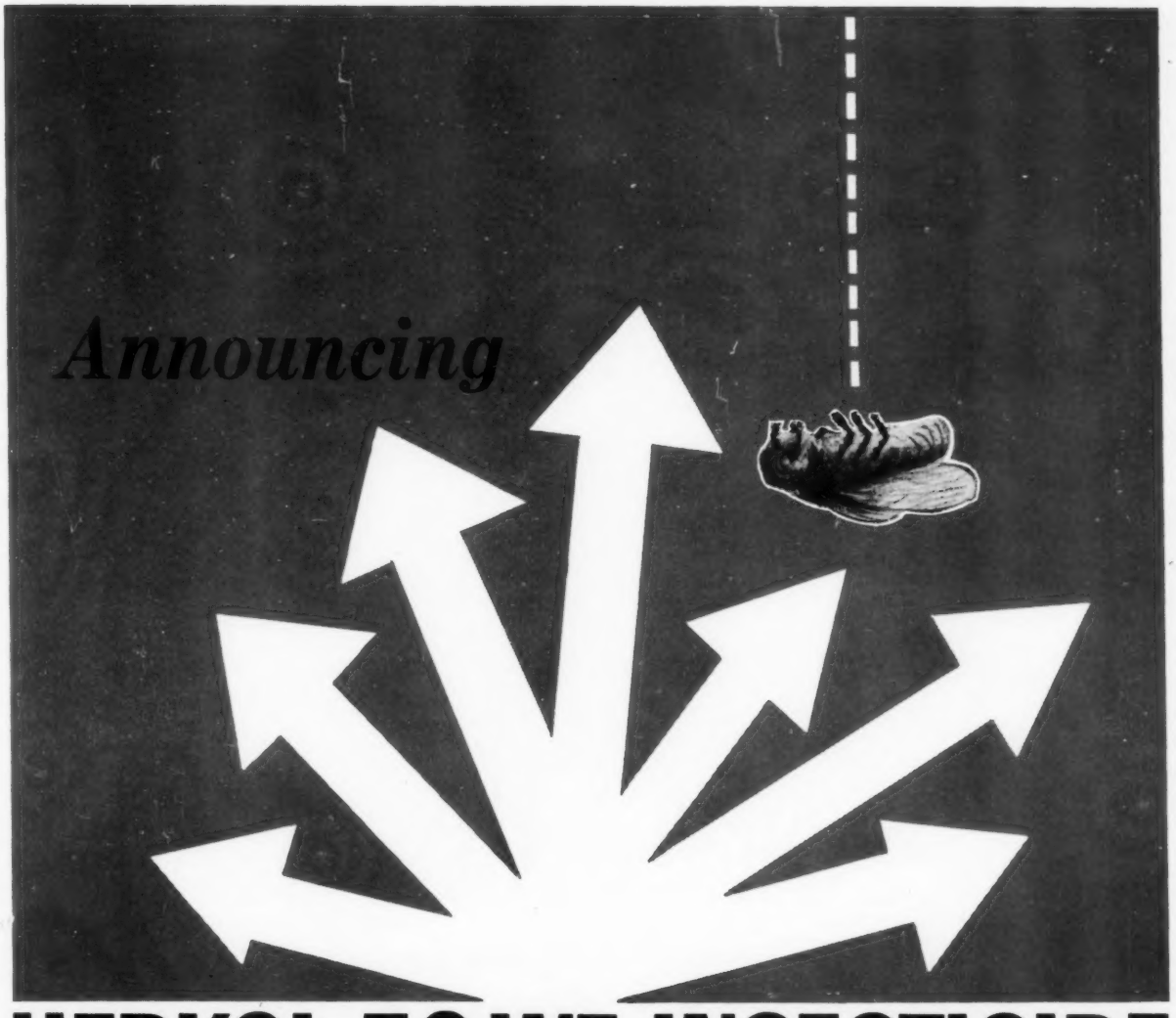

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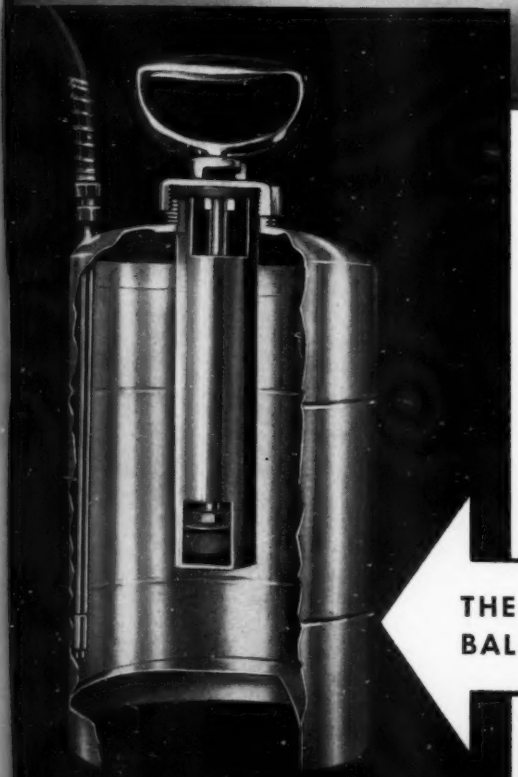

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with 33 confirmed cases and 21 deaths between August 17 to October 15, 1959, a 64% fatality rate. Over 40 horse cases were reported. In 32 of these cases which were carefully studied, only 3 horses recovered. The earliest date of onset in horses was August 6, 1959. More than 20 pheasant flocks displayed clinical disease. Earliest date of onset in pheasant was July 20.

An analysis of available data on human cases suggests that the probable place of exposure for the majority of cases in New Jersey was wooded areas along the coast. This is the area where fresh water bogs merge into brackish water or salt marshes and could very well represent the meeting place between *C. melanura* and *A. sollicitans*, or in other words, *A. sollicitans* and the virus.

Likely vectors in horse cases would include both *A. sollicitans* and *A. vexans*. In the limited live animal biting surveys conducted, no *C. melanura* were reported to have bitten man or horses.

There have been previous outbreaks of eastern encephalitis in New Jersey in birds and mammals (epizootics) but no human cases. One outbreak occurred in 1956 in which both horses and pheasants were affected.

Western Encephalitis

Western encephalitis is found in horses and man in all the states west of the Mississippi and in Illinois and Wisconsin. It is found in birds and mosquitos in limited areas in the East.

Notable outbreaks include:

Year		*Cases*
1941	Western United States particularly the Dakotas and Minnesota	3000
1952	California (Central Valley)	700 human cases

The largest equine outbreak occurred in 1937 and 1938 with over one-third of a million cases and a 20% mortality rate in the 22 states west of the Mississippi River. Iowa alone had 66,000 horse cases in 1938. The mortality rate ranges from 5% to 15% in man and 20% to 30% in horses.

Culex tarsalis is considered the primary vector of western encephalitis. It breeds in great numbers in overflow or seepage from irrigation and in grassland surface pools. Abundance of *C. tarsalis* early in the season and excess precipitation appear to favor outbreaks of this disease.

St. Louis Encephalitis

In general, St. Louis encephalitis has been found in the western and central states, and was recently isolated for the first time in Florida (Beadle, 1959). Some consider it the most important mosquito-borne disease in the United States.

Outbreaks of St. Louis encephalitis appear to be of two types, rural and urban. In the rural outbreaks, St. Louis encephalitis and western encephalitis infections are frequently mixed. Mortality generally ranges from 2% to 11%. Antibody studies have shown wild and domestic birds are commonly infected with this virus, but only a few virus recoveries from birds have been made to date, including one from a mourning dove and one from a flicker.

Culex tarsalis is the principal vector of rural St. Louis encephalitis in the West and *Culex pipiens-quinquefasciatus* complex, the primary carrier of the urban form in central states. The virus has been isolated from *C. tarsalis* several hundred times.

C. pipiens-quinquefasciatus mosquitoes breed in polluted water. In an Ohio valley outbreak, vast numbers were traced to water contaminated by industrial wastes. In the Louisville outbreak, excessive populations of this species were produced from 20,000 to 25,000 street catch basins. St. Louis encephalitis epidemics often occur following droughts. Low rainfall apparently favors the production of *Culex pipiens*, which occurs in sewage water or other man-made breeding places.

Notable outbreaks of St. Louis encephalitis include the following:

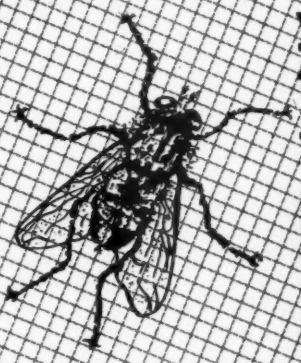
Year	*Location*	*No. cases*
1933	St. Louis, Mo.	1130*
1937	St. Louis, Mo.	500
1954	Hidalgo County, Tex.	1000
1955	Calvert City, Ky. (Pop. 1,500)	13
1956	Louisville, Ky.	110
1957	Texas	120

*More than 200 deaths.

The 13 clinical cases of St. Louis encephalitis in Calvert City, Kentucky, occurred in a population of 1,500. This outbreak was part of a larger occurrence in the lower Ohio River valley. This virus was successfully isolated from the blood of a wild bird (flicker) and from one pool of *Culex pipiens* mosquitoes collected from a chicken house.

An emergency and temporary control program was financed by local industries and directed by

"Well, speak of the devil!"



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town officials. Operations were directed toward elimination of *Culex pipiens* mosquitoes, both larvae and adults. Larval habitats, particularly a polluted slough, were treated with 5% DDT in fuel oil. Adult resting places in outbuildings, especially chicken houses, were treated with 5% DDT emulsion. Individual householders were encouraged to keep their homes free of mosquitoes and to protect their persons by use of repellents.

It is estimated that 300 to 400 acres were larvicided by 3-man crews, and 400 outbuildings were treated by residual spraying. Subsequent surveys by dipping larval samples indicated the control measures were effective.

Current Encephalitis Investigations

Intensive arthropod-borne encephalitis investigations are underway to determine: 1) causes of periodic epizootics and epidemics, 2) epidemic potential for the future, 3) if viruses are continually present in an area or reintroduced, and 4) the most feasible approach to control of encephalitis.

Current information suggests that epidemics or epizootics of mosquito-borne encephalitis are due to a fortuitous set of ecological conditions including 1) high temperatures, 2) heavy mosquito populations, and 3) high rates of virus infections in abundant bird populations. Smaller birds and nestlings circulating high levels of virus in their blood are considered more important than the older and larger birds.

Control Measures for Encephalitis

Two preventive measures are currently practiced, immunization and mosquito control. Immunization is recommended for horses but is not considered economically feasible for humans. A good vaccine is not presently available for human use.

All known measures to reduce and hold mosquito populations at minimum levels are recommended. These include permanent measures, such as filling and draining, and the temporary measure of chemical control. Both power and hand spray equipment are employed for chemical treatment. Control measures should be applied where encephalitis is endemic or epidemic.

Pest Mosquitoes

Pest mosquitoes are receiving more attention in a rapidly growing number of communities in the United States. The public has demonstrated a willingness to pay for such mosquito abatement work based primarily on their importance as pests alone. Pest control operators are contracted to control pest mosquitoes in many areas of the United States.

Pest control operators are already involved in community mosquito control in all parts of the country — usually from the pest or nuisance viewpoint. PCOs in areas where encephalitis is endemic should give more consideration to the health aspects of mosquito control and seek cooperation with local health departments.

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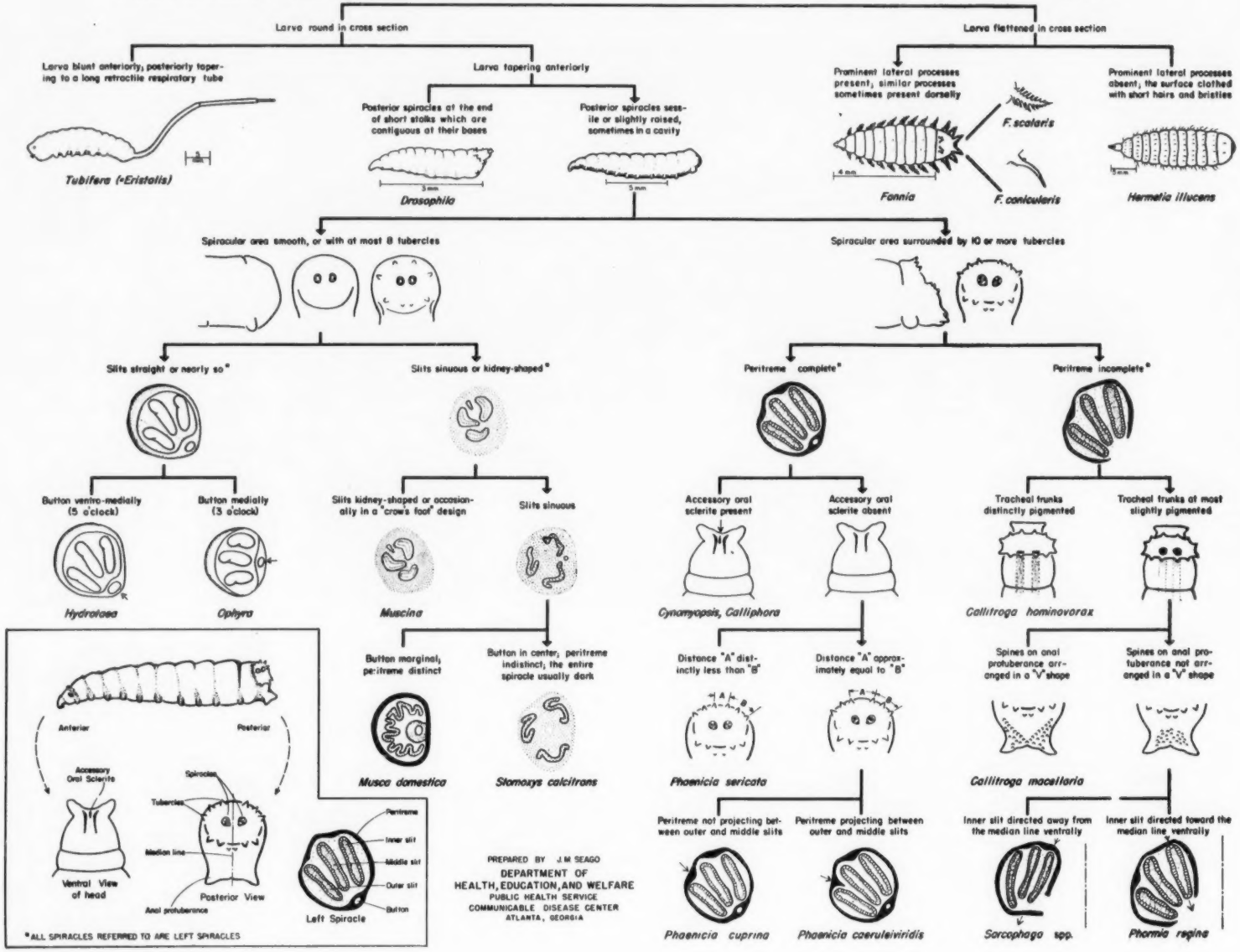
PICTORIAL KEY TO MATURE LARVAE OF SOME COMMON FLIES


Larva round in cross section
Larva flattened in cross section
Larva blunt anteriorly, posteriorly tapering to a long retractile respiratory tube
Larva tapering anteriorly
Posterior spiracles at the end of short stalks which are contiguous at their bases
Posterior spiracles sessile or slightly raised, sometimes in a cavity
Prominent lateral processes present, similar processes sometimes present dorsally
Prominent lateral processes absent; the surface clothed with short hairs and bristles
Tubifera (=Eristalis)
Drosophila
F. scalaris
F. canicularis
Fannia
Hermetia illucens
Spiracular area smooth, or with at most 8 tubercles
Spiracular area surrounded by 10 or more tubercles
Slits straight or nearly so*
Slits sinuous or kidney-shaped*
Peritreme complete*
Peritreme incomplete*
Button ventro-medially (5 o'clock)
Button medially (3 o'clock)
Slits kidney-shaped or occasionally in a "crow's foot" design
Slits sinuous
Accessory oral sclerite present
Accessory oral sclerite absent
Tracheal trunks distinctly pigmented
Tracheal trunks at most slightly pigmented
Hydrotaea
Ophyra
Muscina
Cynomyopsis, Calliphora
Calliroga hominovorax
Button marginal, peritreme distinct
Button in center, peritreme indistinct; the entire spiracle usually dark
Distance "A" distinctly less than "B"
Distance "A" approximately equal to "B"
Spines on anal protuberance arranged in a "V" shape
Spines on anal protuberance not arranged in a "V" shape
Musca domestica
Stomoxys calcitrans
Phoenicia sericata
Calliroga macellaria
Peritreme not projecting between outer and middle slits
Peritreme projecting between outer and middle slits
Inner slit directed away from the median line ventrally
Inner slit directed toward the median line ventrally
Phoenicia cuprina
Phoenicia coeruleiviridis
Sarcophaga spp.
Phormia regina
Anterior
Posterior
Accessory Oral Sclerite
Spiracles
Tubercles
Median line
Anal protuberance
Ventral View of head
Posterior View
Peritreme
Inner slit
Middle slit
Outer slit
Button
Left Spiracle
*ALL SPIRACLES REFERRED TO ARE LEFT SPIRACLES

PREPARED BY J.M. SEAGO
DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
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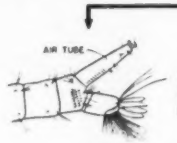
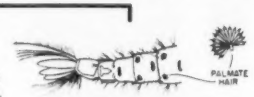
PICTORIAL KEY TO U. S. GENERA OF MOSQUITO LARVAE



Air tube present
Abdomen without palmate hairs

Air tube absent
Abdomen with palmate hairs on middle segments.

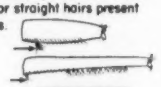


ANOPHELES

Air tube with pecten

Air tube without pecten

Air tube with a basal pair of hair tufts. A row of tufts or straight hairs present in some species.



CULISETA

Air tube without a basal pair of hair tufts Air tube with one to many pairs of tufts or hairs beyond base

Air tube not pointed; without teeth

Air tube pointed and with teeth on one side.

MANSONIA

Air tube with several pairs of tufts or hairs

Air tube with only one pair of tufts or hairs on ventral side.

Eighth abdominal segment with comb scales. If a lateral plate is present, it does not bear hairs.

Eighth abdominal segment without comb scales, but with lateral plate bearing two spinulose hairs.

TOXORHYNCHITES (Formerly MEGARHINUS)

Head with lateral pouches. Rare species found in south Florida and Texas.

DEINOCERITES

Head without lateral pouches.

CULEX

Eighth abdominal segment with a plate bearing a row of teeth on posterior side Head longer than wide; the common species with four stout spines.

URANOTAENIA

Eighth abdominal segment without a plate Head wider than long; hairs not spine-like.

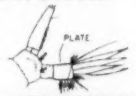
Anal segment with median ventral brush. Eighth abdominal segment with two rows of comb scales.

ORTHOPODOMYIA

Anal segment without median ventral brush. Eighth abdominal segment with only one row of comb scales.

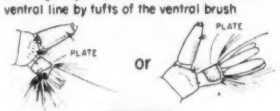
WYEOMYIA

Anal segment completely ringed by the plate which is pierced on the midventral line by tufts of the ventral brush



PSOROPHORA

Anal segment not completely ringed by the plate, or if ringed by the plate, not pierced on the midventral line by tufts of the ventral brush



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Management of Water ✓ FOR MOSQUITO CONTROL

MANAGEMENT OF WATER is of tremendous importance in the control of mosquito production on man-made impoundments, farm ponds, sewage stabilization ponds, salt marshes, and irrigated land. While pest control operators will not have direct authority over how water is treated and stored, they should know what constitutes good water management and where to obtain more information on the subject so intelligent recommendations can be made when such need arises.

"Malaria Control on Impounded Water" is an authoritative book published in 1947 jointly by the old Federal Security Agency and the Tennessee Valley Authority. Information on this 442 page book can be obtained through the U. S. Public Health Service, Communicable Disease Center, Atlanta 22, Georgia. Copies are difficult to locate, but may be available in better public libraries.

"Survey and Control of Mosquitoes of Public Health Importance" is a new 52 page, illustrated booklet just published by the CDC, that will be available from the Superintendent of Documents, Washington 25, D. C.

Water in Reservoirs

Where water is to be impounded, proper preparation of the site will do much to minimize future mosquito problems. Major vegetation must be cleared on the shoreline between high and low water elevations. Low places should be deepened or filled and then the water removed from low places usually by pumping.

Farm, Sewage Ponds

The most important feature in all man-made reservoirs is a steep, clean shoreline with little or no vegetation to provide protection for mosquito larvae.

Many states recommend that one side of a farm pond be shallow and gently sloping to provide easy access for cattle, but that the other sides have steep clean shorelines so that any mosquito larvae are exposed to fish or wave action.

Sewage stabilization ponds may produce large numbers of *Culex* mosquitoes which prefer water with high organic content. Proper shoreline maintenance is of great importance in limiting such mosquito breeding.

Our national multibillion dollar superhighway program requires enormous amounts of fill. The borrow pits along these superhighways should be constructed so that they are either (1) self-draining to prevent the production of temporary pool mosquitoes, such as *Aedes vexans* and *Psorophora confinnis*, or (2) deep enough so that they will hold water at least 2 ft. deep with a steep, clean shoreline to minimize the breeding of such permanent water mosquitoes as *Culex*, *Anopheles*, and *Mansonia*.

Salt Marshes

The vast marshlands along the Atlantic, Gulf, and Pacific coasts are major producing areas for important man-biting *Aedes* and *Psorophora* mosquitoes. Experience has shown that it is not practical or economical to drain all these marshlands, but if it were, draining would conflict with interests of farmers growing salt-marsh hay and of wildlife management workers.

Research by expert mosquitomen indicates that most of the pestiferous *Aedes* are produced in higher portions of the marshes which are less important from a game-management standpoint. These areas are subject to recurrent flooding. There is less *Aedes* production in the lower portions of the marshes with salt grass and wild rice, which are very important in game bird production.

Future research should encourage more surveys to delimit the actual areas which produce mosquitoes. Diking and flooding of these areas would change the marshes so they do not produce as many of the strong-flying, man-biting *Aedes* which breed in temporary pools, and would produce more of the permanent-water-breeding *Culex* which do not fly so far and are less pestiferous. There is probably room for more mutual cooperation between mosquito control and wildlife management organizations.

In Irrigated Areas

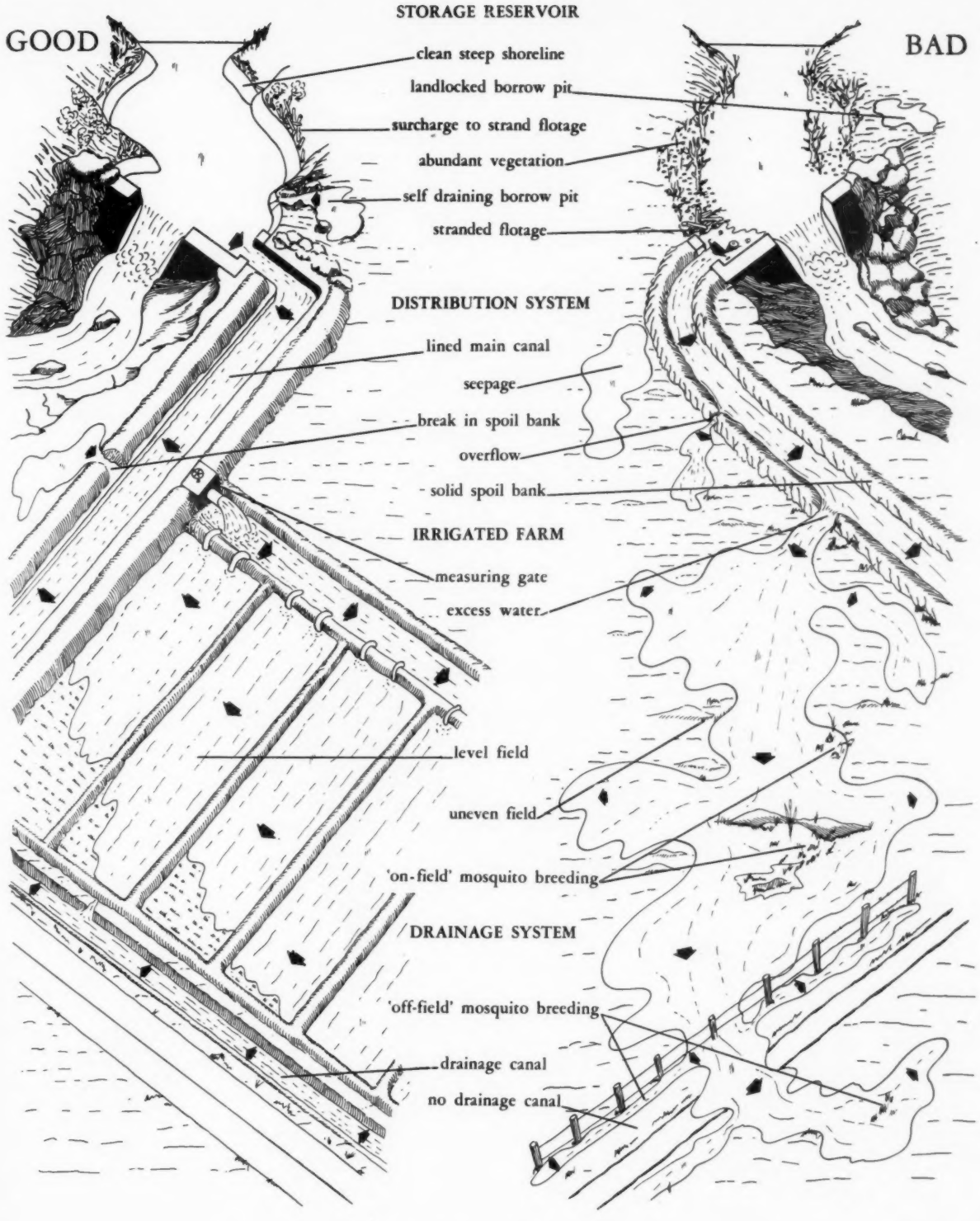
Billions of mosquitoes are produced every year in the irrigated parts of the United States. Some species, such as *Culex tarsalis*, seriously affect the health of man and his animals by transmitting encephalitis viruses. Other mosquitoes, particularly *Aedes vexans*, *A. dorsalis*, and *A. nigromaculis*, are vicious blood-sucking insects affecting the comfort and economic welfare of people, even hindering the planting and harvesting of crops, and industrial development in infested areas.

These problems are particularly acute in the 22 western states where some 20 million acres are already under irrigation and where a million additional acres are coming under cultivation each year.

In these irrigated areas man-made mosquito-breeding places are far more important than natural larval habitats. Mosquito problems arise in 4 distinct areas in an irrigation project: storage reservoirs, the project distribution system, irrigated farms, and the project drainage system. What can be done to minimize problems inherrent in these areas? Here are some recommendations from the American Society of Agricultural Engineers.

Storage Reservoirs. Clear the impoundment of all vegetation in the construction stage. Borrow pits

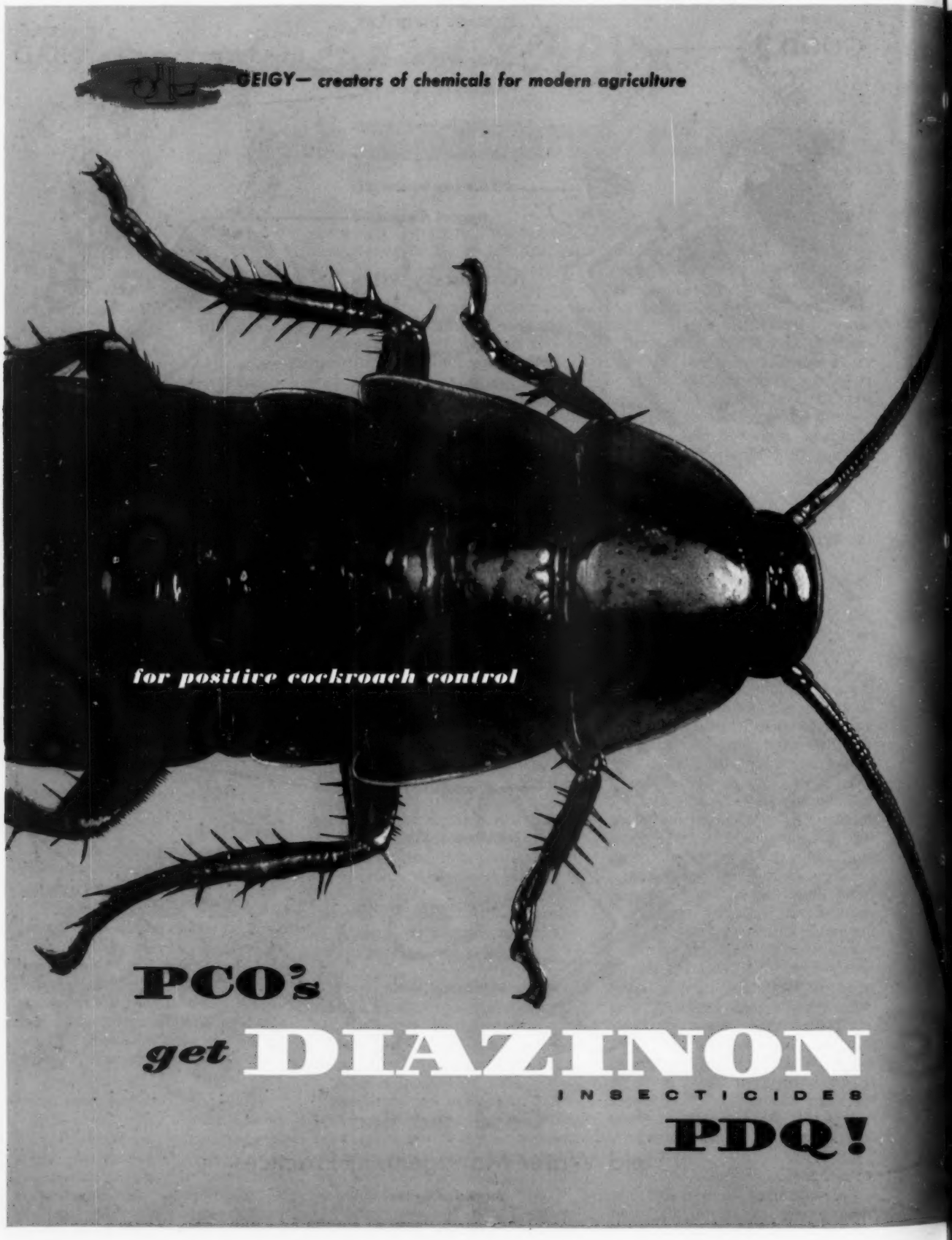
(*Continued on page 72*)



Good and Bad
Field Water Management Practices

Suggested by the

Communicable Disease Center, U. S. Department of Health Education and Welfare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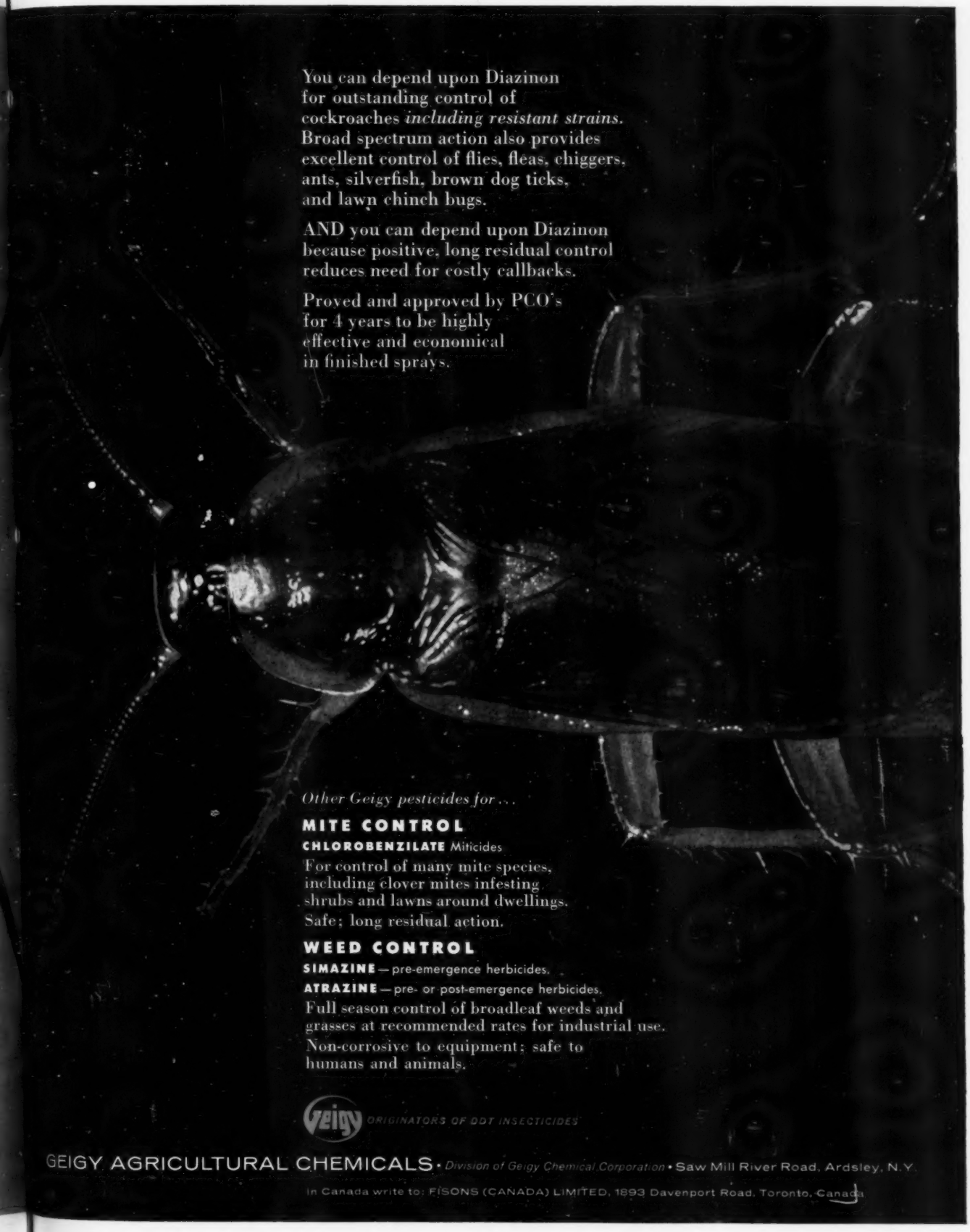
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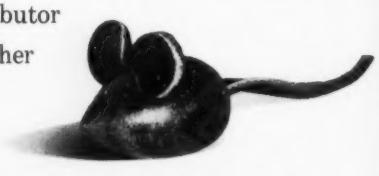

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Correspondence Course in Pest Control Technology

By DR. LEE C. TRUMAN*

Lesson No. 4

Insecticides (2)
Supplementary Substances and Safety

SUPPLEMENTARY SUBSTANCES

REPRESENTATIVE insecticides were discussed in Lesson 3, and it was stated that these insecticides are formulated in a number of different ways. These formulations contain certain *supplementary substances* which are combined with the insecticides in order to make the handling and application of insecticides easier for the PCO. These supplementary substances are of various types, each of which has a particular function.

Liquid supplementary substances which dissolve technical insecticides to form liquid concentrates are known as *solvents*. It is often desirable to use water base formulations in PCO work. Since most of the solvents suitable for making insecticide formulations do not mix with water, *emulsifiers* are included in the concentrates.

Most of the insecticides used by the PCO are applied in rather low concentrations. In order to prepare such formulations large amounts of supplementary substances known as *diluents* are mixed with the concentrates. Water and kerosene are liquids commonly used for this purpose. When insecticidal dusts are prepared for application, some inert dust is normally used as a diluent. Any material which is added to an insecticide will decrease the percentage of the insecticide in the final mixture. Such a material is actually a diluent even though it may not be added for the express purpose of lowering the percentage of the insecticide in the finished product. Solvents are essentially diluents, but a diluent need not be a solvent.

SOLVENTS

Many insecticides are not readily soluble in such normal carriers as oil or water. For this reason they must first be dissolved in an appropriate solvent so they will remain in solution after being diluted with the carrier.

DILUENTS

Diluents are used to reduce the amount of insecticide in any concentrate or technical material to a desired lower concentration for use. Because many of the insecticides available to the pest control operator are supplied in technical or concentrated form, it is essential that the operator know how to make proper dilutions. An error in dilution which may seem minor can, in the course of a year's operation, amount to a considerable sum of money.

For example, many operators made 2% chlordane by adding 2 gallons of technical chlordane to 98 gallons of base oil to make 100 gallons of finished spray. Based on volumes of material, this dilution would have been correct. Insecticide formulations, however, must always be based on the weight of all the materials involved. In this case, technical chlordane weighs approximately twice as much as the usual base oils, so a proper dilution would have been 1 gallon of chlordane to 99 gallons of base oil. Basing the price of technical chlordane at $9.00 per gallon, this error would cost an additional 9 cents per gallon. Over a period of a year this could represent a rather large and unnecessary drain on profits.

In order to make proper dilutions, it is necessary to know a few facts about the products involved and to use these facts properly. It is most necessary to know the weight of the technical material and of the diluent and, where concentrates are being used, the weight of the actual insecticide in a pound or a gallon of concentrate. Most of the formulations used by PCOs are based on percent by weight, so it is important to know the percentage of actual insecticide in a given concentrate. While this figure is important, it is not the only factor which must be considered in preparing proper dilutions. It is also necessary to know how many pounds of actual insecticide are present in each gallon of concentrate. The following example will illustrate the importance of this information. Suppose that you have a 50% concentrate which contains 4 pounds of actual insecticide per gallon. This tells you that each gallon of concentrate contains four pounds of some other material in addition to the four pounds of insecticide; therefore, each gallon of the concentrate weighs 8 pounds. It is easy to see that if 1 gallon of concentrate is combined with 92 pounds of diluent, you will have prepared a formulation containing 4% insecticide by weight.

Variations in the weight of the diluents may make a considerable difference in the number of pounds of insecticide in a gallon of concentrate, but formulations based on weight will always be the same. This is not to say that approximate dilutions are not sometimes the proper dilutions to use. In the pest control industry they are frequently necessary due to the limited mixing and weighing equipment available. Often the measuring equipment on hand is such that it is not practical to split an ounce. However, where a proper formulation has been calculated by weight, it is an

*Correspondence Course Editorial Committee: Dr. John V. Osmun, Dr. Howard O. Deay, William L. Butts, Dr. Philip J. Spear, Dr. Harry D. Pratt, George L. Hockenyos, and James A. Nelson.

Table 4-1

Physical Properties of Some Common Solvents*

Material	Density (lb. per gal.)	Boiling point or range (°F)	Flash point (°F)	Soluble or miscible in
Acetone	6.5	133.7	68	Water, oils
Benzene	7.3	177.8	50-53.6	Water, oils
Cyclohexanone	7.9	311	147.2	Water, alcohol
Fuel Oil No. 2	7	....	130	Hydrocarbons
Kerosene	6.4-6.6	302-572	100-165	Hydrocarbons
Velsicol AR-60	8.2	464-554	464	Oils
Velsicol NR-70	8.7	496.4-674.6	572	Oils
Xylene — 10 degree	7.1	275-293	176	Organic liquids
Solvent naphtha (industrial xylene)	7.2	266-311	194	Hydrocarbons
Water	8.3	212	None	Acetone, benzene, cyclohexanone

*By permission of U.S. Public Health Service, Communicable Disease Center, Atlanta, Georgia.

easy matter to confine the mixing error to ounces rather than pounds. A better answer to this problem is to secure better measuring equipment.

OIL DILUENTS

Petroleum oils are used commonly as diluents for insecticide sprays. Most of these are somewhat lethal to insects when the insect is brought into direct contact with them. However, for the purpose of the pest control operator, this should not usually be considered as a factor in making formulations.

With some insecticides it is necessary for the diluent not only to mix with the particular chemical involved but also to either dissolve or be dissolved by the insecticide. For this reason liquid diluents are often referred to as solvents and different diluents have greater or less solvent power with different insecticides. Kerosene, for example, is soluble with chlordane in any proportion, but it will dissolve only about 4% of DDT. Neither DDT nor chlordane is soluble to any practical extent in water.

Important characteristics of oil diluents are viscosity, flash point, solubility, amount of sulfonatable contents, and specific gravity. A very heavy, viscous oil will not flow readily through a low volume nozzle, may not dry completely and will remain gummy on the treated surface. For this reason the pest control operator usually uses an oil of a lower viscosity. Specific gravity refers to a relationship between the weights of equal volumes of oil and water.

The flash point is the lowest temperature at which an oil will give off sufficient vapor, under defined conditions, to create a combustible mixture. Thus, within limits, the higher the flash point the safer the material. Oils with a flash point of 125°F. are permissible for packaged insecticides. However, the pest control operator should use an oil with a flash point of from 140°F. to 150°F. or even higher if possible, as a matter of safety. Various solvents such as acetone, benzene, xylene, and naphtha all have low flash points and should be used only in the minimum amounts necessary to dissolve the insecticide and should *never* be used as diluents.

The percent of unsulfonatable contents is a measure of the degree of refinement of an oil and shows the degree of safety for its application to plant life. In addition, oils with a low sulfonatable content usually have much less odor.

The degree of solubility indicates the amount of one chemical that can be dissolved in another. It is important to remember that greater amounts of solvent may be necessary in cold than in warm weather.

A summary of these characteristics for some common solvents is given in Table 4-1. Because various texts and reference manuals use these characteristics when discussing solvents, it is necessary that the man who purchases or mixes chemicals knows what they mean. The exact figures for these characteristics of

Table 4-2

Carriers Used for Insecticidal Dusts

Diluent	Chemical Name	Source Material	pH	Properties
Attaclay	attapulgite	clays	7	fibrous particles
Bentonite	montmorillonite	clays	9-10	non-abrasive; holds pyrethrum and nicotine well
Calcite	calcium carbonate	limestone	8-9	alkaline: may break down some chemicals
Diatomite	silica	diatomaceous earth	5-8	abrasive*; very low bulk density, spicular
Gypsum	hydrated calcium sulfate	gypsum	7-8	undesirable high bulk density
Hydrated lime	calcium oxide	limestone	12-13	alkaline, may saponify insect tissue
Kaolin clay	kaolinite	clays	5-6	particles flat to granular
Pyrophyllite	hydrated aluminum silicate	pyrophyllite	6-7	non-alkaline; platelike particle; non-abrasive
Sulfur	sulfur	sulfur	acid	fine crystalline or amorphous powder
Talc	hydrated magnesium metasilicate	soapstone and other rocks	6-10	non-abrasive; dusts may be spicular; fibrous, granular, or plate-like.

*Abrasive dusts have insecticidal value in themselves.

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any solvent can usually be obtained from the company from which it is purchased.

DUST DILUENTS

An insecticidal dust may be either a relatively pure chemical (such as powdered sulfur), an inert carrier on which the liquid chemical has been sprayed and dried (called an impregnated dust), or a powdered insecticide thoroughly mixed with an inert dust.

Some of the common dusts used as diluents are talc, pyrophyllite, attaclay, and bentonite. Common characteristics of these, together with some others, are listed in Table 4-2.

WETTABLE POWDERS

Proper dilutions using wettable powder concentrates can be made in the same manner by reference to Table 4-3.

Table 4-3

Dilution Table for

Preparing Suspensions from Wettable Powders*

Percent Water Wettable	Pounds wettable powder required for 100 gallons of finished spray at percentage levels below				
	0.25	0.5	1.0	2.5	5
75	2.6	5.3	10.7	26.7	53.3
50	4	8	16	40	80
25	8	16	32	80	160

*By permission of U.S. Public Health Service, Communicable Disease Center, Atlanta, Georgia.

MAKING PROPER DILUTIONS

Where it is desired to make formulations more accurately than is possible by using the preceding tables, exact formulations must be used. In any case, with a given insecticide, the formulation should be figured at least once by the mathematical formula to check against the table to see if there is enough variation in cost to justify using the one method over the other.

When most of us think of an amount of a solid, it seems quite natural to think in terms of weight. It is the normal thing for us to think of a *ton* of coal or a *pound* of hamburger. Unfortunately, it seems just as natural for us to think of a *quart* of oil and a *gallon* of gasoline. This practically universal quirk in our everyday thinking is probably the most troublesome of the stumbling blocks which we encounter in making proper dilutions of insecticides which involve liquids. The problem is simply that of having to make dilutions on the basis of percent by *weight* using materials which we commonly think of in terms of units of *volume*.

In order to overcome this difficulty it is important to have a clear understanding of the concept of *specific gravity*, which is an expression of relationship between the weight of a given volume of any liquid and the weight of an equal volume of water. Most of us have heard (and likely have used) the expression "oil is lighter than water." This is essentially a rough expression of the basis for understanding the idea of specific gravity. We know, for example, that a gallon of kerosene is lighter than a gallon of water. If we weigh the gallon of kerosene we will find that it will weigh approximately 6.49 pounds. Upon weighing the gallon of water, we will see that it will weigh about 8.34 pounds. Since the weight of water is the standard for comparison, we divide 6.49 by 8.34 and get the figure 0.78. This is the specific gravity, and it indicates that one gallon of kerosene is only 0.78 times as heavy as one gallon of water. Always remember that, if the specific gravity of a liquid is less than 1.0, it is lighter than water; if the specific gravity is greater than 1.0, the liquid is heavier than water.

To Prepare A Certain Quantity of Insecticide In Terms of Weight

$$X = \frac{S \times A}{C}$$

X is the amount of concentrate required in mixture
S is the % of active ingredient in the finished material
A is the amount of spray or dust to be prepared
C is the % of active ingredient in the concentrate

Example: — Prepare 100 pounds of 2% pyrethrum dust using talc and 5% pyrethrum dust concentrate.

$$X\ (5\%\ \text{pyrethrum dust}) = \frac{2(\%\ \text{of finished dust}) \times 100(\text{total amount})}{5(\%\ \text{of concentrate})}$$

$$X = \frac{2 \times 100}{5}$$

$$X = \frac{200}{5}$$

X = 40 pounds of 5% pyrethrum dust necessary

Add the 40 pounds of pyrethrum dust to the difference between 40 and 100 pounds. Therefore, combine 40 pounds of pyrethrum concentrate and 60 pounds of diluent to make 100 pounds of dust containing 2.0% pyrethrum.

To Compute A Dilution Rate

When dilution rates are discussed, they are expressed in terms of *proportional* parts. This is not an expression of *particular* units of measure. Parts may be combined using *like* units of measure. If a dilution rate is stated as one part of concentrate to four parts of water by volume, you could combine one quart with four quarts, or one pint with four pints. The percentage of the insecticide in the finished product will be the same. The following formula is designed to compute such dilution rates.

$$X = \left(\frac{C \times (\text{specific gravity of concentrates})}{S \times (\text{specific gravity of diluent})}\right) - 1$$

X is the number of parts of diluent to add to one part of concentrate
C is the percent active ingredient in the concentrate
S is the percent active ingredient in the finished material

Example: Dilute a 25.0% lindane oil concentrate having a specific gravity of 1.2 to make a 1.0% solution, using kerosene (specific gravity 0.78) as the diluent.

$$X = \frac{25 \times (1.2)}{1 \times (0.78)} = \frac{30.0}{0.78} = 38.5 - 1$$

X = 37.5

Use 37.5 parts of kerosene to 1.0 part of 25.0% concentrate.

To Formulate Liquids On A Weight-To-Weight Basis

As noted previously, it is now necessary to consider the specific gravities of the solutions in order to make the proper dilution. The following modification of the above formula is necessary to make this correction:

$$X = \frac{S \times (\text{specific gravity of diluent}) \times A}{S \times (\text{specific gravity of diluent}) + (C\text{-}S) \times (\text{specific gravity of concentrate})}$$

X is the number of gallons of concentrate needed in the total gallons of the finished spray.
S is the percent of active ingredient in the finished spray.
A is the number of gallons of finished spray to be prepared.
C is the percent of active ingredient in the concentrate.

Example: Prepare 100 gallons of a 5.0% spray material using a concentrate containing 25.0% DDT and having a specific gravity of 1.5. This concentrate is to be diluted with kerosene which has a specific gravity of 0.78.

$$X(\text{gallons of concentrate}) = \frac{5 \times 0.78 \times 100}{(5 \times 0.78) + (25 - 5) \times 1.5}$$

$$X = \frac{390}{3.9 + (20) \times 1.5} = \frac{390}{3.9 + 30} = \frac{390}{33.9}$$

X = 11.5 gallons of 25% DDT concentrate needed

Add this to 88.5 gallons of kerosene to prepare 100 gallons of finished spray containing 5.0% DDT.

To Figure The Capacity of Sprayer Tanks In Gallons

Cylindrical tanks

Multiply the length in inches by the square of the diameter in inches. Multiply this product by .0034 for capacity in gallons.

Elliptical tanks

Multiply the length in inches by the short diameter in inches by the long diameter in inches. Multiply this product by .0034 for capacity in gallons.

Rectangular tanks (square or oblong)

Multiply length in inches by width in inches by depth in inches. Multiply this product by .004329 for capacity in gallons.

●

SAFETY

IF YOU ARE to avoid costly delays, accidents, and damage suits, you must be safety conscious at every stage of your operation. You must not only protect yourself and your customers against possible poisoning from the chemicals being used, but must avoid all other kinds of accidents as well.

Chemical Poisoning

The most obvious hazard in the pest control industry is the poisoning which may result from the various chemicals used to control insects and rodents. Many persons think of these poisons as being dangerous only if eaten. They fail to take into consideration the other ways by which pesticides may enter the body. It is absolutely necessary that the pest control operator be aware of every possible way a chemical he is using may be harmful to himself, to his customer, to products, or to property. After all, if a chemical can kill an insect or a rodent, it is likely that it has toxic properties which make it hazardous to man.

Chemicals are toxic to man and his domestic animals in varying degrees depending both on the type of chemical involved and on the way the chemical enters the body. This entry may be in any of 3 different ways: breathing into the respiratory tract, by mouth into the digestive tract, and through the skin. There will also be a variation in toxicity with each chemical formulation depending on whether the material is used as an oil solution, water emulsion, wettable powder, or dust. These differences are generally a function of the ease with which the insecticide penetrates the skin, which in turn is influenced by the formulation of the insecticide. If the toxicities of insecticides are compared by injecting doses into the body cavities of insects on the one hand, and intravenous injection in mammals on the other, there is frequently little difference in toxicity to the two kinds of animals. Pyrethrins, for example, are very toxic to warm blooded animals if administered intravenously. Insecticides which have entered the body by one or more of the routes mentioned above, are picked up and distributed through the body by the blood.

Toxicities are usually expressed for experimental animals as LD_{50}. This simply means the amount of a given chemical which will kill 50% of a group of a particular kind of test animals. The term is only a reference figure for the pest control operator to use in comparing the toxicities of different chemicals.

Chemicals taken into the respiratory tract by breathing are frequently nearly as dangerous as those taken into the blood stream by injection. The lining of the lungs that separate the air from the blood are extremely thin and permit rapid, often complete absorption of a poison. The lungs are richly supplied with blood which returns to the heart and is then pumped to all parts of the body. This type of poisoning is quite important to the pest control operator since many of the chemicals he uses are in a mist or dust form and can be easily taken into the lungs.

Poisons entering the body through the mouth are absorbed usually much more slowly than those taken in through the lungs. Normally only a portion of the digestive tract will absorb the poison, which is diluted somewhat by the contents of the digestive tract.

The membranes which separate the poison from the blood in the digestive tract are thicker, and a poison may pass through the tract and be eliminated from the body before being completely absorbed.

While the skin offers more protection from the absorption of poisons than do the lungs or the digestive tract, there are many factors which make skin absorption a problem to the pest control operator. The extensive skin surface is the most likely portion of the body to come in contact with an insecticide. Failure to remove chemicals from the skin promptly can be quite hazardous because a few of those used by the operator are absorbed very easily.

You can reduce the hazards of the chemicals used both to yourself and to your customer. When mists or dusts are being introduced into the air in any quantity, the client should leave the premises and the operator should wear a respirator of a type approved by the U. S. Department of Agriculture for the insecticide being used. If any significant amount of insecticide is deposited on the skin or clothing, the operator should wash promptly and thoroughly with soap and water, and should change clothing as soon as possible.

Read The Directions

Read the manufacturer's directions carefully and follow them completely for each chemical you use. If protective devices such as respirators or rubber gloves are recommended, use them without fail. Do not use leather gloves. When gloves are necessary they should be completely non-absorbent.

In all uses of an insecticide, be very conscious of its possible effect on your client. If an insecticide has a high vapor toxicity, it must not be applied in large quantities in unventilated rooms. Only the relatively non-toxic form of rodent baits, such as red squill and the anticoagulants, can be used in buildings where children are living or even where they may visit. You must also be careful of your clients' property. You must not get pesticide on house plants, in fish tanks, on food products, or on food containers or utensils of any kind.

The pest control operator should know how to give immediate first-aid in cases of accidental poisoning. Detailed directions, such as those given by the Committee on Toxicology of the American Medical Association for first-aid in poisoning, should be available in each service kit.

FIRST-AID MEASURES FOR POISONING

The aim of first-aid measures is to help prevent absorption of the poison. SPEED is essential. First-aid measures must be started at once. If possible, one person should begin treatment while another calls a physician. When this is not possible, the nature of the poison will determine whether to call a physician first or begin first-aid measures and then notify a physician. Save the poison container and material itself if any remains. If the poison is not known, save a sample of the vomitus.

Measures to Be Taken Before Arrival of Physician

SWALLOWED POISONS

Many products used in and around the home, although not labeled "Poison," may be dangerous if taken internally. For example, some medications which are beneficial when used correctly may endanger life if used improperly or in excessive amounts.

In all cases, *except those indicated below*, REMOVE POISON FROM PATIENT'S STOMACH IMMEDIATELY by inducing vomiting. This cannot be over-emphasized, for it is the essence of the treatment and is often a lifesaving procedure. Prevent chilling by wrapping patient in blankets if necessary. Do not give alcohol in any form.

A. Do Not Induce Vomiting If:

1. Patient is in coma or unconscious.
2. Patient is in convulsions.
3. Patient has swallowed petroleum products (i.e., kerosene, gasoline, lighter fluid.)
4. Patient has swallowed a corrosive poison (symptoms: severe pain, burning sensation in mouth and throat, vomiting.)

CALL PHYSICIAN IMMEDIATELY

(a) Acid and acid-like corrosives: sodium acid sulfate (toilet bowl cleaners), acetic acid (glacial), sulfuric acid, nitric acid, oxalic acid, hydrofluoric acid, iodine, silver nitrate (styptic pencil).

(b) Alkali corrosives: sodium hydroxide — lye (drain cleaners), sodium carbonate (washing soda), ammonia water, sodium hypochlorite (household bleach).

If the patient can swallow after ingesting a *corrosive poison*, the following substances (and amounts) may be given:

For acids: milk, water, or milk of magnesia (1 tablespoon to 1 cup of water).

For alkalis: milk, water, any fruit juice or vinegar.

For patient 1-5 years old: 1 to 2 cups

For patient 5 years and older: up to 1 quart.

B. Induce Vomiting When Non-Corrosive Substances Have Been Swallowed:

1. Give milk or water (for patient 1-5 years old — 1-2 cups; for patient over 5 years — up to 1 quart).
2. Induce vomiting by placing the blunt end of a spoon or your finger at the back of the patient's throat, or by use of this emetic — 2 tablespoons of salt in a glass of warm water.

When retching and vomiting begin, place patient face down with head lower than hips. This prevents vomitus from entering the lungs and causing further damage. When vomiting resulting from ingestion of petroleum oil cannot be prevented, be sure to follow this precaution to reduce the chance of getting material into the lungs.

INHALED POISONS

1. Carry patient (do not let him walk) to fresh air immediately.
2. Open all doors and windows.
3. Loosen all tight clothing.
4. Apply artificial respiration if breathing has stopped or is irregular.
5. Prevent chilling (wrap patient in blankets).
6. Keep patient as quiet as possible.
7. If patient is convulsing, keep him in bed in a semidark room; avoid jarring or noise.
8. Do not give alcohol in any form.

SKIN CONTAMINATION

1. Drench skin with water (shower, hose, faucet).
2. Apply stream of water on skin while removing clothing.
3. Cleanse skin thoroughly with water; rapidity in washing is most important in reducing extent of injury.

EYE CONTAMINATION

1. Hold eyelids open, wash eyes with gentle stream of running water *immediately*. Delay of few seconds greatly increases extent of injury.
2. Continue washing until physician arrives.
3. *Do not use chemicals;* they may increase extent of injury.

INJECTED POISONS

(scorpion and snake bites)

1. Make patient lie down as soon as possible.
2. Do not give alcohol in any form.
3. Apply tourniquet above injection site (e.g., between arm or leg and heart). The pulse in vessels below the tourniquet should not disappear, nor should the tourniquet produce a throbbing sensation. Tourniquet should be loosened for 1 minute every 15 minutes.
4. Apply ice-pack to the site of the bite.
5. Carry patient to physician or hospital; DO NOT LET HIM WALK.

CHEMICAL BURNS

1. Wash with large quantities of running water (except those caused by phosphorous).
2. Immediately cover with loosely applied clean cloth.
3. Avoid use of ointments, greases, powders, and other drugs in first-aid treatment of burns.
4. Treat shock by keeping patient flat, keeping him warm, and reassuring him until arrival of physician.

Measures to Prevent Poisoning Accidents

A. Keep all drugs, poisonous substances boric acid and other household chemicals out of reach of children. *This includes all insecticides and rodenticides.*

B. Do not store nonedible products on shelves used for storing foods.

C. Keep all poisonous substances in their original containers; do not transfer to unlabeled containers. Material in unlabeled containers should be destroyed.

D. Do not use beverage bottles for insecticides.

E. Destroy all empty containers by burning, or clean them completely before re-use.

POISON CONTROL CENTERS

Poison control centers have been established in many areas to provide to the medical profession information concerning the prevention and treatment of accidents involving the ingestion of poisonous and potentially poisonous substances. This service is available on a 24-hour daily basis. The pest control operator should contact his local health department or medical society to determine the location of the nearest such center. Keep the name, phone number, and address of the nearest center near your office telephone where it can easily be found. This information should also be attached to the inside of each serviceman's kit. In case of a poisoning accident, tell the attending phyisician what poison is involved and, in case he does not have the information at hand, tell him how to reach the nearest poison control center. In general these centers will provide information to physicians only. Laymen should first call their physician or a hospital and call the center only if a physician cannot be reached.

Emergency information can be obtained day or night by telephoning the United States Public Health Service, Atlanta, Georgia.

MECHANICAL EQUIPMENT

Safety precautions must be taken with all mechanical equipment, both in the shop and on the job.

Where equipment is power driven, all moving, driving parts such as universal joints, drive shafts, belts, pulleys, and chains should be covered with protective guards to reduce the hazard of catching clothing and fingers in them. The operator must be especially careful not only to install these guards in the first place, but also to see that they are replaced after having been removed for any reason. It is good practice to assume that external moving parts of power equipment are hazardous, and to install adequate guards before an accident occurs. Loose clothing, neckties, rings, and jewelry should not be worn around moving machinery since these things can easily become entangled in moving parts.

Grinding Machines

Each grinding machine used for sharpening tools should be marked plainly "Do not operate without goggles" and a pair of protective safety goggles should be kept on each machine so that it is impossible to overlook them when beginning work. This is most important, even when only a small bit of grinding is to be done since it takes only a small fragment of material, thrown off by the grinding wheel, to cause a serious eye injury. A grinder should be securely fastened to a firm support, chipped or cracked wheels discarded, and the speed of rotation should not exceed the recommended maximum. Home-made grinders are extremely dangerous if they lack proper covers, lighting and tool rests.

Pumps And Hoses

All power pumps used in the shop or on the job should be equipped with a pressure regulator and liquid return bypass. If there is no bypass, the pump may deliver a greater pressure than the hose can withstand. Liquid shot out of a ruptured hose not only results in lost material but also can cause serious injury to the operator and can damage property. Even if the material in the hose is not poisonous, serious physical injury can result. Solvents and base oils can cause serious injury if sprayed into the eyes. The rated working pressure of a hose or spray equipment must equal and preferably exceed the maximum pressure that will ever be used in that equipment. Hoses become weakened with use and age, and old hoses often will not stand high pressure. Hoses should be replaced as they show signs of age or wear.

All valves and gaskets that could cause leaking insecticide to come in contact with your hands or body must be kept in good repair. Even a small, continuous contact with many chemicals can cause a degree of chronic toxicity.

Sharp corners or projections which can cut should be filed down, removed, or covered on all pest control equipment.

Tanks and drums should be mechanically pressurized only when they are designed for such a purpose, and only when a pressure gauge and safety valves are present and working properly. Hand-spray tanks should not be subjected to more than the manufacturer's recommended maximum pressure.

Pest control operators should be particularly careful to see that their cars and trucks have all necessary safety equipment in good repair. Brakes, lights, stop lights, turn lights, windshield wipers, and horns should always be in good operating condition. The greatest safety feature in all automotive equipment is the driver who should always be wide awake and alert to any driving hazards that may occur.

Vehicle First-Aid Kit

Each vehicle should have a first-aid kit containing as a minimum: band-aids, a roll of 2″ gauze bandage, 2x2 inch gauze compresses, a bottle of antiseptic, a tube of burn lotion, a tube of eye ointment, a pair of sharp-pointed forceps, a small pair of scissors, and a large triangular bandage suitable for making a tourniquet. An additional first-aid kit should be easily available in each office. Every serviceman should be trained in first-aid procedures with instructions also on what treatments to leave to a physician, such as fractures, serious burns, and eye injuries.

Electrical Equipment

Electric power tools are particularly hazardous to a pest control operator. It may seem unnecessary to say that all such equipment should be kept in good repair; however, a glance at the electrical equipment used in many pest control operations will easily show why this is one of the greatest hazards the average operator encounters.

You must be very careful to use electric cords of sufficient capacity to handle the load to be put on them. Ordinary household extensions, usually of No. 18 wire, are not sufficient for any pest control operation, for the wire is too light and the insulation is not heavy enough to give sufficient mechanical protection to the wire. Only heavily insulated, industrial-type wire should be used, preferably in a wire size not smaller than No. 14, even in extension cords for a single electric light. All wire used by a pest control operator should have an outer covering which is resistant to the chemicals he is using.

Simple breaks in the outer insulation of a wire may be safely taped over. Any break in the inner insulation calls for making two cords from the original one, using heavy duty fittings.

With extension cords and lights, use only heavy industrial-type plugs, preferably those having a clamp to keep the wire from pulling out, and made of rubber or other similar materials. The hard plastic plugs sold for household use are entirely unsafe for heavy, continuous use. Be very careful with extension cords to see that the outer insulation of the wire extends entirely inside the plugs or sockets at each end and that the wires inside are firmly attached to the terminals provided. When a light is attached to an extension cord, be sure the light socket is made of heavy metal, rubber, or porcelain, and is well insulated. Special "rough service" bulbs are available that do not break as easily as standard bulbs. Any bulb should be surrounded by a wire cage device. Again, household type equipment is not heavy enough for industrial use and may cause serious injury.

The wiring on electrical tools must meet all of the standards as to size, insulation, and installation mentioned for extension cords. In addition, *all electrically driven tools should be wired for three-wire service so they can be easily grounded*. You may be using heavy duty equipment, and you may keep it clean and in good repair, but this will not prevent it from shorting out when not grounded and from causing a fire or more serious accident.

Grounding Electric Tools

Most household circuits which pest control operators use are wired for two-prong plugs rather than three. This deficiency can easily be overcome, however, by using an adapter placed between the three-

wire cord from the tool and the two-prong socket. These adapters are equipped with a short green wire which can be grounded simply by loosening the small screw which holds the plate covering the outlet box and fastening the short wire of the adapter to it. This will work effectively where the electrical outlet boxes in the house are grounded, but in many installations, this is not the case. A better and safer method is to solder or firmly clamp a piece of No. 18 copper wire, about 10 to 20 feet long and not necessarily insulated, to the short wire and attach a heavy clamp such as a battery clamp to the other end. This clamp is then attached to the nearest metal water pipe, gas pipe, or water faucet and makes a positive ground. Be sure that the clamp is secured on *bare metal* in order to get a good ground connection. Plastic plumbing cannot be used as a ground connection.

Each operator must examine all electric cords and connections before using them to make certain that all insulation is sound and that all connections are tight. Be sure that the power cord is adequately insulated where it enters a tool. Check periodically to see that internal wear has not damaged insulation. Failure to do this can cause a very serious and unnecessary accident.

Fuses

Many electrical circuits now being installed in buildings are equipped with circuit breakers to prevent overloading. Older circuits, however, are usually equipped with fuses of the screw-in type. In household wiring, these should never be heavier than 15-20 amps. The blowing of a fuse indicates that too heavy a load is being placed on the circuit with a consequent danger of fire if the fuse did not burn out. A pest control operator should never replace fuses with anything heavier than 15 to 20 amps. When using heavy motorized equipment, the heavy load placed on the wiring at the time the equipment starts will frequently burn out fuses. This can sometimes be overcome, however, by the use of time delay fuses which will withstand a temporary short overload without burning out. Use time delay fuses of no more than 15 to 20 amps, and then only after an inspection shows the wiring to be in good condition.

It is impossible to emphasize too strongly the necessity for observing these safety precautions in the use of electrical equipment. Electrical shocks are sudden and unexpected. A pest control operator in the crawl space under a house, or standing on a damp floor, has very little opportunity to save himself when a shock does occur. Prevention of shock should always be the first consideration when working around electricity. Electrical shock is considered the most common cause of accidental death to workers in the pest control industry. With this in mind, the management is justified in insisting that employees wear shoes with soles and heels made of some non-conductive material.

In case an electrical shock should occur, it is very important to remove the victim from contact with the live conductor as quickly as possible. Turning off the source of electrical supply is the safest way to do this, if it is possible. *Do not* attempt to remove the victim from a live wire with your bare hands because you will probably only become another victim of the accident. Use rubber gloves, a dry stick or rope, heavy, dry cloth such as a coat, or other non-conductors to make certain that you do not come in contact with the current.

It is of utmost importance to apply first-aid measures as fast as possible in severe electrical accidents. Usually the victim will have stopped breathing, so artificial respiration must be commenced at once. If there is another person present, send him to call a physician, but begin the artificial respiration at once. If you are alone, call the physician only after breathing in the victim has become strong and regular. There are many other injuries such as burns and fractures which may occur at the time of electrical shock, but if you delay artificial respiration so the victim does not breathe again, the physician will never have the opportunity to treat him.

Artificial respiration should be started without removing the victim any farther from the point of the accident than is necessary to avoid further shock. Artificial respiration should be continued either until the patient is breathing strongly and regularly by himself or until rigor mortis has set in. When the patient starts breathing again, watch him closely because he may stop breathing and you must start over again.

Keep the patient protected from chilling by covering him with blankets and using hot water bottles if necessary.

If the patient should revive before the physician arrives, keep him lying down, warm, and do not permit him to exert himself.

Every serviceman should be taught how to administer artificial respiration because this procedure is required not only in electrical accidents but also in cases of drowning and inhalation of poisonous gases as well. The accepted techniques are well established. Local Red Cross instructors and others trained in such techniques can usually be called on to instruct pest control personnel.

STORAGE AND USE OF MATERIALS

Many of the chemicals used in pest control work require some attention to safety precautions in their storage, use, and transportation.

Solvents, particularly, must frequently be handled with care since many of them are either flammable, produce toxic fumes, or both. Flammable and toxic chemicals should always be kept in closed containers away from any source of excessive heat or open flame. If possible, store them in a separate building which has adequate ventilation to remove promptly any fumes which may be produced. If they must be stored inside a building where people work, check regularly to see that the containers are tightly sealed.

When handling any solvent, do not permit it to come in contact with the skin, do not breathe the vapors, and if clothing should become contaminated, change as quickly as possible. Many solvents can be absorbed readily through the skin and failure to remove contaminated clothing can cause serious toxic effects in a very short period of time.

Some of the insecticides used, particularly the organo-phosphates and the chlorinated-hydrocarbons require special precautions. Because of their possible vapor toxicity in a closed room, these chemicals should be stored in tightly closed containers.

When these insecticides are being used, there is very little danger to the operator in making spot treatments for insect control so that protective clothing is not usually necessary. However, when they are applied in confined spaces, in overhead applications, and under conditions of prolonged exposure, an approved respirator and proper protective clothing should be worn. When these chemicals are used as a fine mist, there is danger of breathing in the particles and also of contaminating the clothing. Many insecticides can be ab-

sorbed through the skin, usually without any irritation, so that contaminated clothing should be removed and the skin thoroughly washed with soap and water as soon as possible. Contaminated clothing should be laundered before being worn again.

All hazardous chemicals such as Compound 1080, thallium sulfate, arsenic trioxide, and strychnine should be kept in securely locked containers, and dispensed as needed only by a responsible individual.

All dust insecticides should be handled so the operator does not breathe the dust particles.

In general all insecticides and rodenticides, even the so-called non-toxic ones, should be handled as poisons; do not eat or drink them, do not breathe the dust or vapors, do not contaminate the clothing or skin with them, and do not permit them to get into food or food preparation utensils. Wash hands with soap and water before eating or smoking.

When transporting pest control chemicals, be sure they are in tightly closed containers. Whenever possible, the operator and the chemicals should be in separate compartments of the vehicle in order to avoid danger from toxic vapors or from spillage in accidents. Glass bottles should be packed securely to prevent accidental breakage in the service vehicle.

FIRE PRECAUTIONS

Fire is an ever-present danger in many pest control operations. Wood and paper about the shop, flammable solvents and insecticides, and electrical and gasoline powered equipment all create the possibility of fire. Every pest control operator, as a matter of safety, should check his premises frequently for the presence of fire hazards and should correct promptly any that he finds. If the local fire marshall does not check the premises regularly, the operator, for his own protection, should call him and request him to do so.

Uncovered containers of oil and oil based insecticides are an open invitation to fire and should not be permitted regardless of size.

Electrical circuits should be checked regularly to see that they are not overloaded. The frequently seen mass of extension cords plugged into one outlet should be removed.

One of the most serious fire hazards in pest control work is the accumulation of oily rags. These should always be washed promptly and not permitted to remain in service kits or on shelves even overnight. If this is not possible, they must be kept in tightly closed metal containers since they can very easily start a serious fire by spontaneous combustion.

The best way to control fire is to prevent it. Close attention to and removal of fire hazards is time and money well spent, for a serious fire can easily cause injury and property damage that can put many a firm out of business. Smoking should be prohibited in areas where any flammable material is stored or handled. Storage areas should be well separated from a shop area where gasoline engines are run or grinders are operated in order to reduce the chances of fire.

Welding on pest control equipment is often hazardous because of dangerous fumes. Before any welding is started, the equipment should be cleaned thoroughly and all solvents removed. The safest approach is to take the equipment to an experienced welder who will know what precautions should be taken before any repairs are made.

It is of utmost importance to every pest control firm to maintain an adequate number of the proper type of fire extinguishers. These extinguishers must be placed in such a way that a person should not have to travel more than 50 feet to get one in case of an emergency. Extinguishers are rated according to the type of fire for which they are suited. Table 4-4 lists the types of fires and the types of extinguishers recommended for each.

Although the carbon dioxide extinguisher is not recommended for class A fires, it can be used successfully on small class A fires. There is no danger involved when used in this way, and it is better to attempt to use a CO_2 extinguisher than to do nothing. The dangers involved in using water, soda-acid, or foam extinguishers on class B and C fires is greater than the danger from the fire itself. These extinguishers should be used only on class A fires.

Always remember that fire extinguishers are intended only for the purpose of combating small fires as they begin. Call your local fire department and make every attempt to keep the fire under control.

The rules of safety are simple: do everything possible to prevent accidents; in case of doubt about the safety of any procedure, don't do it; in case of doubt about the safety of any chemical, don't use it; and if, in spite of this, you should have an accident, know first-aid procedures to handle it and call the fire department, police, or a physician promptly whenever necessary.

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Table 4-4

Types of Fires And Types of Extinguishers To Use

	Class A	Class B	Class C
Materials Involved	wood, paper, cloth	oils, solvents, greases	electrical
Extinguishing Method	cool and quench	blanket out air	cooling and blanketing
Types of Extinguishers to use	water, soda acid, foam	CO_2, foam, or dry chemical	CO_2, or dry chemical
Cautions	protect extinguishers from freezing	do not use water; avoid carbon tetrachloride (hazardous fumes)	do not use water, soda acid, carbon tetrachloride

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New Pestmaster* Spot Shot for Cereal and Food Handling Equipment is a mixture of two well-known fumigants, ethylene dibromide (70%) and methyl bromide (30%). It has excellent penetrating and killing power, vaporizes slowly, and has a distinct warning odor for added safety. It is packed in handy 1½ oz. cans to save you time, labor, and material costs. There is no waste, no bulk handling. Each can is easy to handle, provides an effective, yet economical dose. These advantages make Pestmaster* Spot Shot ideal for overnight or weekend sanitation servicing of bakeries, breweries, flour mills, feed elevators, macaroni factories, and food dehydrating plants. If you're *not* enjoying accounts like these, get Pestmaster* Spot Shot and go after them.

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New Pestmaster* Fumigant 73 for All Bulk Grain Storages combines the same fumigants, 70% ethylene dibromide and 30% methyl bromide. Both are widely used to fumigate large-scale bulk grain buildings. Now, the advantages of each — excellent penetration and high-killing power — are combined. Pestmaster* Fumigant 73 is ideal for the treatment of localized infestations in aerated buildings or for small bins without aeration. Packed in handy 6 oz. cans for fast, labor-saving application. Pestmaster* Fumigant 73 vaporizes slowly; has a distinct warning odor for greater safety. Start fumigating bulk grain for *new profits* with Pestmaster* Fumigant 73.

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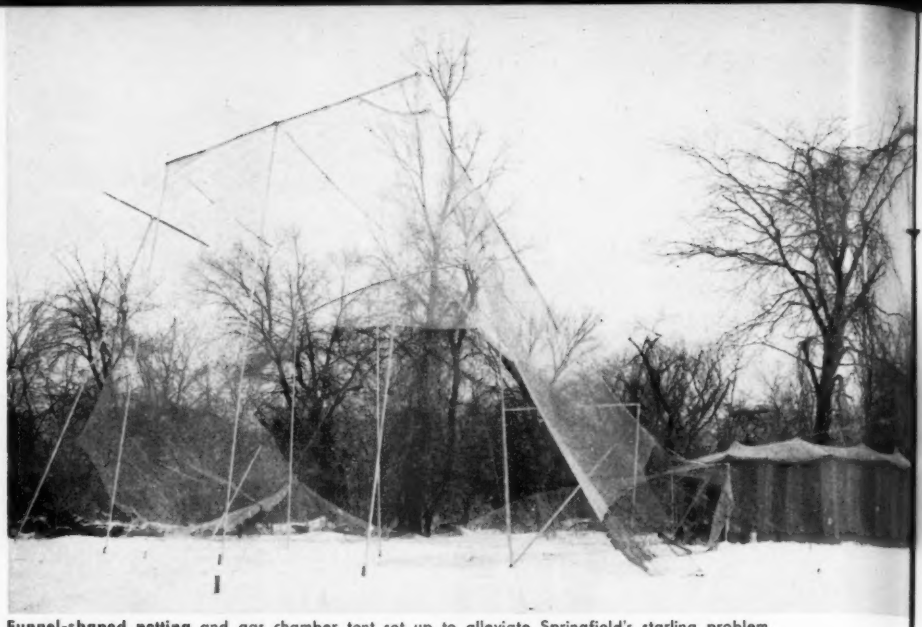

Funnel-shaped netting and gas chamber tent set up to alleviate Springfield's starling problem.

Springfield's Light Trap Snatches 75,000 Starlings...

...was it worth the cost?

HOW PRACTICAL is it to construct a huge light trap to control undesirable birds? Can results of a light trap drive justify the time and money required for such an operation? These were questions answered recently by an experiment in Springfield, Ill., where more than 75,000 starlings met their death in a gas filled chamber of a light trap.

An over-populated roosting site which created a health hazard on the outskirts of Springfield prompted officials of the U. S. Fish and Wildlife Service to find out just how effective a light trapping program would be. Interest in the operation brought volunteers from Illinois and Indiana Conservation Departments, Purdue University's Engineering Staff, Sentinel Pest Control Laboratory in Springfield, Springfield Sanitation Department and Power and Light Company, and the Edinburg, Ill. Chapter of the Izaac Walton League.

Flock of 500,000

A neglected and abandoned four acre pear orchard was the fall bird roosting site for many years, but in the winter of 1960 some 500,000 feathered creatures came to roost there and created the acute problem.

The mass of birds included some grackels and cowbirds, but was predominately made up of starlings. Many had been driven from downtown sections of the city in a previous drive conducted successfully by George L. Hockenyos of Sentinel Laboratory (PC, Oct. '60, pg. 11). While several wolf trees, 40 to 50 feet high, were heavily inhabited by the birds, bulk of the flock occupied branches of trees no higher than 30 feet from the ground.

Four Arches for Funnel

Under direction of John Webb, of the U. S. F&WL's Patuxent Research Center in Laurel, Md., crews erected four arches of 2-inch aluminum piping which served as braces for cotton and nylon netting. Height of the arches ranged from 35 feet to 10 feet, arranged one behind the other to form a tunnel-shape when the netting was laid over them.

At the small neck of the tunnel a 10 by 15 foot canvas tent was set up which was sealed around the base with snow to prevent gas leakage. This tent served as the gas chamber.

A battery of five 1000-watt, incandescent, 220 volt light bulbs, fed by an electric cable attached to a nearby, municipally-owned power transformer, was placed on a home-made aluminum reflector and set up about 8 feet inside the opening of the tent. Four additional 150-watt, outdoor sealed beam flood lights were placed 20 feet in front of the tent. After an initial drive, four 300-watt PAR 56/NSP 120 volt spotlights in 3520-A cast aluminum holders were added to the battery of lights inside the tent.

According to animal biologists Galen C. Oderkirk, and William D. Fitzwater of Purdue University, lights are the most important single factor in the entire operation against starlings. The experts believe there cannot be too many lights to draw the birds into the tent in such an operation.

Drive Must be in Dark

With a supply of hydrogen sulfide, calcium cyanide "A" dust, and 120 feet of rubber hose strung

Powerful lights used to attract starlings to their deaths. Notice two 600-watt units are placed two feet in front of battery of five light, 5000 watt panel. Dead birds are piled up between lights.

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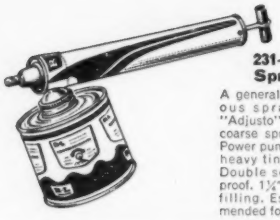

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276—Seal-Tight® Sprayer

4 gallon capacity, corrosion-resistant stainless steel tank, with exclusive Seal-tight locking cover and electrically welded seams. Easy stroking 1¾" x 15½" seamless brass pump. 42" oil and chemical-resistant hose, rotatable shut-off, 24" brass extension with exclusive Revolvo® nozzle that turns full circle.

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5 gallon stainless steel sprayer with a positive piston stainless steel pump developing pressures up to 100 lbs. Tank back has double wall for greater comfort. Dasher agitator keeps solution well mixed. Use with any spray material. Pump handle can be mounted right or left. 5 ft. hose, fully rotatable shut-off, 24" brass extension with exclusive Revolvo® nozzle.

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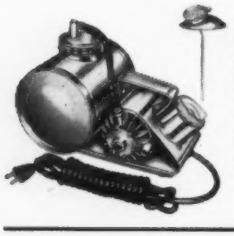

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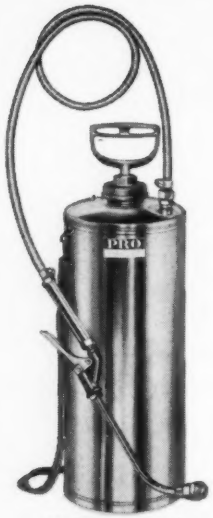

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around the sides of the tent with $\frac{3}{32}$ in. holes drilled at 6-in. intervals to act as gas jets, the drive was ready to begin.

A band of volunteer "drivers" entered the major roost area on a dark, moonless night and on a given signal began making noise to scare the birds from branches of the trees. At the same time the battery of lights was turned on to attract the birds to the tent. Ideally, the night should be pitch black so there is no other light to attract birds away from the trap.

In one such drive, 40,000 starlings, 100 grackels, and 200 cowbirds were trapped and gassed. In another drive, 22,000 starlings were victims of hydrogen sulfide gas and calcium cyanide dust. There were seven drives in all, resulting in death to 75,000 starlings, 125 grackel, and 324 cowbirds.

Cost is 1.6 cents per Bird

Materials for the Springfield light trap operation cost an estimated $1,210 with some of the material furnished free. With the 75,000 starlings eliminated in the drives, cost per bird was 1.6¢. This did not include labor and time devoted to the operation.

"Because of the high costs, this is hardly an operational project," Oderkirk reported. "Especially in view of the fact that this program did not solve the starling problem or eliminate the roost."

However, the biologist made recommendations that would cut costs in the construction of a future trap. He said the first two supporting arches in the Springfield trap were expensive, laborious, time-consuming, inflexible, and dangerous.

"We feel they can be effectively replaced by a prop-and-mast system. In future operations we visualize raising two or more individually guyed front masts, 45 or more feet high. Toe plates of 2.5 inch channel iron, instead of angle iron, would be helpful in raising masts. A pulley eye welded to the top of each mast would enable quick flexibility in raising or lowering the net as the occasion demanded. The remainder of the funnel shape would be formed by jointed prop poles and ropes tied to stakes and trees," Oderkirk pointed out. "This type of construction should cut frame costs

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by one-third, erecting costs by almost three-quarters and, in addition, would considerably increase the total catch."

Test Eliminated "Bugs"

Although the Springfield project was not heralded a success by residents of the area and by those who cooperated in the program, the experiment gave officials experience enough to improve future trap construction and execution. Trial-and-error methods often prove to be the best way to learn about a new procedure and it was indicated by those who participated in the Springfield program that the next trap would be more effective and less expensive.

Tying some loose net ends together is U. S. F&WL's John Webb, who directed trapping operations.

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$25 Million Spent Annually for Aquatic Weed Control, Meet Learns

(*from page 18*)

sociates of N.Y., said that the need for a persistent algicide of low toxicity is urgent. Algae in waterways is becoming an increasing serious problem in fish management, recreation lakes, watersheds, farm ponds, and in general, most any body of fresh water.

Officers elected at this year's meeting were: president, Edward J. Longtin, White Bear Lake, Minnesota; 1st vice-president, Paul W. Eller, Chipman Chemical Company; 2nd vice-president, David Papier, Ohio Department of Wildlife; and secretary-treasurer, Kenneth Mackenthun, 4126 Meyer Avenue, Madison, Wisconsin.

Elected to the Board of Directors were: Dr. Duncan McLarty, University of Western Ontario, Canada; Dr. Robert C. Hiltibran, Illinois Natural History Survey; Lyle Hill, Reasor-Hill Company; Henry P. Carsner, Tacoma, Washington; and Dr. B. Domogalla, Applied Bio-Chemists & Associates.

Next convention of the Aquatic Weed Control Society will be held on February 13th and 14th, 1962, in the LaSalle Hotel, Chicago, Illinois.

Plan Texas Mosquito Project

Heavy Texas rains in the past few months have prompted officials of Aransas, San Patricio, and Refugio Counties to launch a tri-county mosquito control program.

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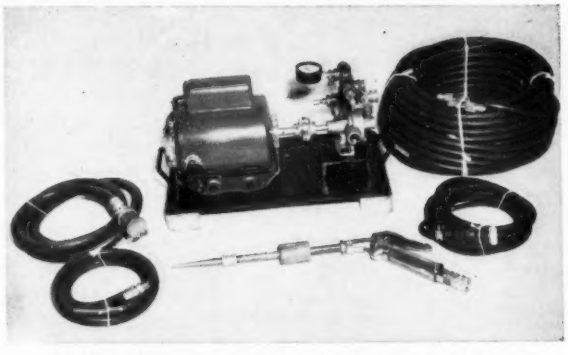

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Will Wood Preservatives Block Termite Tubing?

by DR. HORACE O. LUND

Head, Department of Entomology, University of Georgia, Athens

Eastern subterranean termites, (*Reticulitermes flavipes* (Kollar)), attack wood and other cellulose materials not in direct contact with the ground because they have the ability to construct tunnels or tubing of earth and saliva over surfaces of masonry or other materials which they cannot penetrate. These tubes provide runways between the nest and the cellulose food materials within which the delicate termites are protected from light, extremes of humidity and, perhaps, enemies. Certainly if completed shelters are found between the ground and the cellulose food materials, it is reasonable to assume that worker termites are carrying cellulose food through these shelters to their nests in the ground and that, if this cellulose food is a structural timber, damage is being done. Contrariwise, observations indicate that where tunnels are not built over these impervious materials the worker termites soon cease to crawl across and transport food over these surfaces.

Tube Over Treated Wood

In the last few years, it has been suggested that the simple interposition of sills, floor joists, and subfloors of wood treated with rotproofing chemicals between the termite colony in the ground and the untreated wooden parts of the building above would provide an effective termite barrier. A series of simple tests has shown, however, that worker termites will tube over pine wood treated with some of the most widely used wood preservatives. This suggests that, while the treated wood itself may remain uneaten and sound, the untreated wood above may be damaged by termites that have tubed across the treated "barrier."

Experiments were run in our laboratory as follows:

A block of wood, partly eaten by termites, was tacked on top of a pedestal of treated pine wood about 1″ x 1″ x 6″. The pedestal was then stood on end in about 2 inches of dampened soil in the bottom of a museum jar 6″ in diameter and 8″ high. Approximately 500 termites (workers, soldiers, and secondary reproductives) were placed on the top block and allowed to crawl or drop to the soil below. A black sateen cover cloth was placed over the museum jar to exclude light and the jar was held at room temperature. If no shelters were constructed, and the termites died out, the procedure was repeated until complete tubes were constructed.

After an Osmose-treated pedestal was placed in the jar with the termites, complete tubes had been constructed over it in 9 days; over a pedestal cut from an old pressure-creosote-treated power-line pole in 12 days; over a freshly pressure-creosoted pre-cut pedestal in 19 days; over a pedestal soaked for 1 week in a 2% solution of copper naphthenate in fuel oil in 27 days; and over a pedestal commercially treated with Wohlman salts in 28 days. Photographs of some of these tubed-over pedestals are shown in Figure 1.

Two pine pedestals soaked in a 2% solution of pentachlorphenol in fuel oil for several days were not tubed over until almost precisely 2 years after treatment, even though the termites continued to crawl freely up and down over the treated pedestals for several hours after each test was started. It would appear then that the ability of this pentachlorphenol application to prevent tubing by termites persisted not longer than two years.

Similarly, we were unable to induce tube building over pine pedestals treated with copperized chromated zinc chloride until after 14 trials over a period of 16 months after treatment. On the 14th trial, the tube was completed in 2 days in one replicate and in 6 days in another.

Tests have just begun with pedestals commercially treated with Copperized Boliden Salt preservative and Cellcure wood preservative.

Test Treated Masonry Voids

In a National Pest Control Association sponsored project, an effort is being made to determine whether subterranean termites will build tunnels over the surfaces of voids in foundations and pillars when these void surfaces are

Figure 1. Termites were able to tube over wood treated with Osmose (left), Wohlman Salts (center), and creosote (right), to reach untreated wood laid on top of each treated pedestal.

Figure 2. One of the plaster of Paris tubes, 3½ ins. long, that were dipped in various soil poisons to test termites' willingness to tunnel over them.

treated with the common termite control poisons. Plaster of Paris tubes 3½″ long and 3½″ in diameter were placed in 8″ museum jars on 2″ of clay soil. A block of termite eaten wood was laid on top of the cylinder and about 5000 termites were placed onto the dirt under the moulded tube. (Figure 2). A black cloth was placed over the jar. In several cases, tunnels were constructed over the untreated plaster of Paris cylinders, which were usually completed within four days. Six-inch lengths of concrete drain-tiles also were similarly placed.

These plaster of Paris and concrete test cylinders were dipped in and out as quickly as possible of various concentrations of Aldrin, dieldrin, and chlordane emulsions and then set aside for drying and aging.

Cement cylinders were dipped for one second in dieldrin emulsions in concentrations of 1.5%, 0.15% and 0.015%; in aldrin emulsions of 1.0%, 0.1%, and 0.01%; in chlordane emulsions of 2.0%, 0.2% and 0.02%.

The plaster of Paris cylinders were dipped in dieldrin emulsions of 0.54%, 0.054%, 0.0054% and 0.00054%; aldrin emulsions of 0.5%, 0.05%, 0.005%, 0.0005%; and chlordane emulsions of 2.0%, 0.2%, 0.02% and 0.002%.

After a total of 58 tests on the treated cylinders, tunnels had been completed only on the plaster of Paris cylinders treated with the lowest concentration of chlordane (0.002%) seven weeks after treatment. Nine months after treatment, we were unable to induce the termites to build tunnels over the cylinders treated with the lowest concentrations of aldrin (0.01% on cement cylinders and 0.0005% in plaster of Paris cylinders) or dieldrin (0.015% on cement cylinders and 0.00054% on plaster of Paris cylinders) or the second lowest concentration of chlordane (0.02%). We plan to continue these tests for at least 2 years longer.

Plan Soil Tests

Another project sponsored by the NPCA has as its objective the development of a practical bioassay technique for the rapid determination of the concentrations of termite control chemicals in soil. NPCA support is in the form of a graduate student research fellowship, held by Mr. Rodney Coleman, an excellent student with experience in practical pest control work.

On the basis of a literature survey and actual trials, the best test organism will be selected. Some of the criteria for selection will be: ease of preparing the soil samples,

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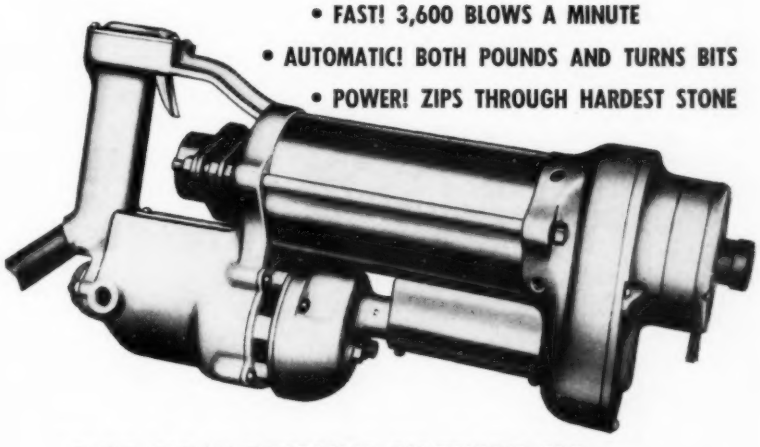

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9/32 - 4	1.33	2.66	3.33
9/32 - 6	1.33	2.66	3.33
5/16 - 4	1.40	3.33	4.00
5/16 - 6	1.40	3.33	4.00
3/8 - 4	1.53	3.73	4.40
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ease of standardizing test conditions, speed of completion of tests, ease of procuring test organisms, and the uniformity of susceptibility of the test organisms to the chemicals. From a preliminary literature survey, it would appear that the common Drosophila fruit fly (wild type) will best meet these requirements. From actual experiment, the details of the technique will be developed.

Soil samples treated with various known concentrations of the commonly used termiticides will then be tested with the method selected and the results plotted on a curve from which soil samples containing unknown amounts of chemicals can be read back to concentration.

Techniques for sampling the soils around buildings will also be investigated in order to develop uniform procedures.

On this project so far, the work has been largely preliminary library study.

What We Still Need to Know About Termites

by VIRGIL K. SMITH, JR.

Southern Forest Experiment Station, Forest Service
U. S. Department of Agriculture, Gulfport, Mississippi

Termite control by chemical soil treatment has been tried and developed without much knowledge about how and why it is effective. Answers to such questions as the following are still needed: How does a barrier of treated soil stop termites? Are they repelled or are they killed? Will a strong persistent colony penetrate after sacrificing a few thousand workers? Just how do termites get through a treated layer — do they penetrate it slowly, or move rapidly after the chemical breaks down or is dissipated?

There is a definite need for a quick, reasonably accurate method to help predict how long a given chemical treatment will be effective in a soil of known type and pH. Though fully exposed to the weather, applications of aldrin, chlordane, and dieldrin are still 100% effective after 11 to 12 years in sandy loam soil in southern Mississippi. Will they remain effective ½, 2, 4, or 10 times as long under buildings, in other types of soil, in soil of high or low pH values, in areas of high or fluctuating water tables, or in the presence of various building materials? There are some indications that chemicals used in treating soil under buildings do remain effective longer than when exposed in field tests.

Other soil treatment problems pertain to the distribution of chemicals, especially under concrete slabs already in place and on various types of fill to be pretreated. How close together should the holes through a slab be spaced for adequate distribution within the fill? How can one be sure of adequate treatment when there is a gravel or cinder fill beneath the slab? In pretreating, when is the best time to apply the chemical — before or after the aggregate fill is in place? Can termites tube over the various coarse aggregates that are treated with insecticides, and should the soil below such fill be treated also? How much chemical is needed if both soil and aggregates are well treated? Do fumigants have a place in control of termites under a slab? Perhaps a combination residual-fumigant treatment could be used to control existing infestations and prevent further attacks.

To obtain the answers to many of these questions, researchers must delve into many basic phases of termite biology and behavior. We need to know how the insects use wood as food and how they locate or are attracted to wood that sometimes can be reached only by extensive tubing or tunnel building. PCOs might find good use for attractants or repellents. More information on diseases and other enemies of termites might lead to cheaper and more effective controls.

These are a few of the unknowns concerning termites. In view of the combined efforts that are being made by government agencies, universities, and private industry to find answers to such questions, I am confident that new and useful knowledge will be forthcoming.

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Hornets from this papery nest no longer cause trouble for Tampa, Fla. mother.

Wasps' Stray Brings Bill Gresham's Spray

To paraphrase an old adage, "Anywhere you hang your jacket is home." And to a colony of yellow jackets, home was a weird, swirly paper nest fused to the lower trunk of a skinny tree on the edge of a woods in Tampa, Fla.

It might have been a peaceful home if it weren't for a few hostile nesters who stung a neighborhood boy while he was playing in the vicinity. This irked the boy's parents who demanded eviction by local authorities.

A gob of red-tape enveloped the mother's efforts when she was told by the county health department she would need a permit from the fire department to burn the insect nest. The fire marshall reportedly refused to issue any such burning permit, and when she called police for help, they reportedly shirked away from the touchy job.

The housewife's dismay, reported in the local newspaper, caught the eye of William B. Gresham, Jr., of Gresham Exterminators in Tampa, who offered to eliminate the yellow jackets and their nest as a civic contribution.

Ernest Perez, Gresham's sales manager, and servicemen Tony Gonzalez and Ronald Kelsey came to the scene armed with 35 gals. of 56% malathion water emulsion, a 150-gal. tank, John Bean power sprayer with a Bean high pressure adjustable nozzle, and a truck load of determination.

They soaked the nest and the adjacent ground with the entire 35 gals. of insecticide. "We had to use a rather strong dosage of malathion," Gresham told PC, "because the yellow jackets spread their living quarters into the ground beneath the tree. We had to get enough malathion down there to get the job done." The mother apparently rests easier now when her son goes out to play. Gresham has had no call-backs; the wasps have apparently hung up their yellow jackets and died away.

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What's NEWS In The Industry

Algae Promising Repellent Va. Mosquitomen Hear

Florida's successful results in screw-worm control by sterilizing males through radiation has stimulated research with algal repellents for mosquito control. This is what delegates to the 14th Annual meeting of the Virginia Mosquito Control Association learned from Charles E. Gerhardt, chief of the Communicable Disease Center's Region III Services in Charlottesville, Va.

According to the association's secretary-treasurer, Dr. R. E. Dorer, Gerhardt told the group that a promising theory being investigated deals with certain algae which produce toxic materials mosquitoes shy away from. He said tests have shown that mosquitoes will not breed in water containing these algae.

In addition delegates heard reports on insecticides, equipment, encephalitis, and training, delivered by government and university mosquito experts.

Praising the results of Dibrom in mosquito control was Dr. John Fluno, entomologist for the U.S. Department of Agriculture's In-

(Continued on page 70)

W. Va. Forming PCA

David O. Quinn, extension plant pathologist and entomologist of West Virginia University in Morgantown is joining with PCOs in the state to form an association of industry firms. Plans are now in the making.

For more information write Mr. Quinn, or Eugene E. Workman, Tops-All Termite Control, 2874 Piedmont Rd., Charleston, W. Va.

N. Caro. PCA To Join NPCA

By resolution of its membership, the North Carolina Pest Control Association has requested recognition as an affiliated unit of the National Pest Control Association. Action was taken on January 18 by the general membership and the resolution forwarded to the NPCA by NCPCA secretary, Bob Hutchcraft, last month.

Workshop Plan Makes Last Month's Penna. State College PCO Short Course Success

A junior workshop, similar to the NPCA Major Workshop in Nashville, Tenn. last year, was the pattern followed by 40 participants in the 15th Annual Penn State PCO Conference at State College, Pa., March 7-9. Built around NPCA committees, the format instigated audience participation to make, what officials called, "the most successful conference Penn State has ever held."

Rodent control committeeman John Becker, of Tri State Sanitation in Pittsburgh, revealed that that the addition of 12% denatured alcohol to liquid baits depresses the freezing point and increases acceptance. The value of 1080 was debated, but delegates finally agreed that there is no good substitute for this highly toxic rodenticide in stubborn situations.

Philadelphia PCO Dale Fleming's fumigation report lead to an hour long discussion in which Alex Ehrlich, J. C. Ehrlich Co., Lancaster, described pinpointing concentrations of fumigants in old house borer control. He drills a series of ¼" holes between studs at various heights and injects ¼ to ⅓ lb. methyl bromide from a dispensing can, tubing, and needle valve. Holes are closed immediately after the gas is injected. He does this pinpointing in addition to regular fumigation procedures for control of this wood borer.

Advantages of Dow Chemical Company's new Vikane fumigant were spelled out. More "do's and don'ts" were detailed, including the recommendation that fans should not be used to help distribute Vikane during the actual fumigation. Fans detract from the fumigant's efficiency, delegates were told, because the increased build-up of air pressure under tarp fumigation forces the Vikane out under the sandbags.

Dr. Hubert Frings, of Penn State, brought to Martin Meyer's session on bird management much practical experience with sounds. Dr. Frings cited specific areas where reproduction of distress calls worked well and ascribed some of the failures with this method of bird control to faulty public relations and a lack of knowledge of bird biology. Compound 1070 was mentioned as a temporary antifly-ing additive to food which would incapacitate only sparrows and cowbirds, leaving desirable song

Okla. PCA Has "Pest Control Week" With Help from Velsicol

April 3 to 9 is "Pest Control Week" throughout the state of Oklahoma. It is sponsored by the Oklahoma Pest Control Association with cooperation of Velsicol Chemical Corp.

PCO members have successfully received a proclamation from Oklahoma's governor, and from numerous city mayors in an effort to "promote the health and well-being of the citizens of Oklahoma."

Although Velsicol has provided the plan itself and offered its guidance, sales promotion materials, newspaper ad mats, and publicity releases, the promotion is entirely an association effort.

More details of what took place and how successful the total effort has been will be presented in a forthcoming issue.

T-H Sells to Con Electron

Consolidated Electronic Industries Corp. has purchased all assets of Thompson-Hayward Chemical Co., in exchange for an undisclosed amount of stock, according to an announcement from C. T. Thompson, and R. S. Thompson, chairman and president, respectively of T-H. No operational or management changes are contemplated.

R. S. Thompson said Thompson-Hayward would materially complement the product scope of the chemical, pharmaceutical, animal, and plant health activities of Con Electron's subsidiary, Philips Electronics and Pharmaceutical Corp.

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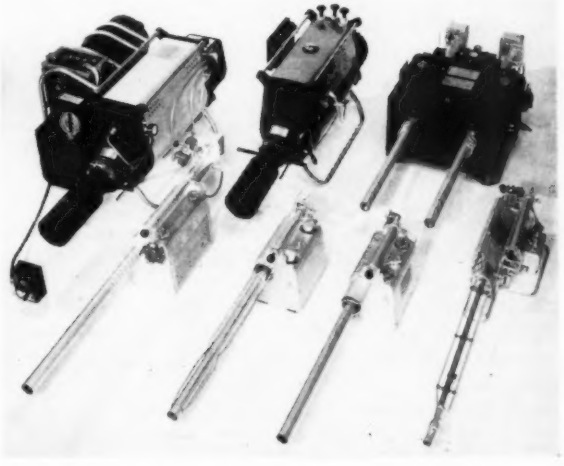

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birds alone. Doubt of such specificity among species so closely related was expressed.

Philadelphian Martin Meyer also headed a session on new insecticides during which Chemagro's Baytex organic phosphate insecticide was lauded. It's a new compound, high in cost, with a reported promising future in this industry, according to Alex Ehrlich.

John Ebner, of National Pest Control Co. in Pittsburgh, reported excellent control of a stubborn, resistant German cockroach problem with a DDVP-syrup bait intended for fly control.

"Future control measures for German cockroaches, will, if no chlordane-type material appears, utilize toxic bait-attractant materials and toxic dusts in the 5 micron range," according to Pittsburgher Harry Katz. "New diluents, such as Micro-Cel, are making distribution and penetration with dust more thorough than with the older 40 micron dusts."

A recent change in the NPCA's termite pretreat warranty program, according to an announcement made by association secretary Dr. Ralph E. Heal, permits the inclusion of coverage for a storeroom if a dwelling adjoins.

Abbeon Model No. R560 Container Type Hygrometer measures the relative humidity of grainy or powdered samples of such materials as tobacco, grain, flour, wheat, oats, etc. Developed by the Abrax Instrument Corp., the unit calculates moisture within materials in about 20 minutes. Samples to be tested are inserted into the aluminum container and the Hygrometer is capped over the top of the can, holding the moisture inside. For more details about this measuring device write the company at 179-15 Jamaica Ave., Jamaica 32, N. Y.

"New concepts in Termite Ecology" by Koppers Co. researcher, Dr. Anders Lund, opened new vistas to delegates. Continuing on a theme expounded at Purdue in 1960, Dr. Lund described fungal species which are attractant, nutritional and/or antagonistic, or actually toxic. He revealed the toxic principal in one species, *Lentinus lepideus*, to be methyl cinnamate, and described its practicability as a wood protectant. Cost and water solubility are principal detractors.

Dr. Lund brought up the possibility of destroying populations of termites biologically. Temperature limits of termites were also described; Lund having started a series of tests to yield more data. New figures are promised after cold-hardening period experiments have been run.

"New Concepts in Soil Poisoning" by Harry Katz described the tremendous liquid-holding capacity of soils and listed the many pitfalls that befall toxicants in the soil to justify the continued use of high levels of toxicant concentrations currently recommended. He suggested one new way to treat water pockets under basement

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floors is to pour in 1 to 2 oz. of an emulsifiable concentrate of a toxicant, drop in some paradichlorobenzene, which is said to volatilize under water, and then cement the hole closed.

Gulf Oil researcher, Arnold Mallis, reported an instance where German cockroaches hid in the folds of beer cases. The problem was solved by the discovery of an effective repellent and a redesigning of the cases themselves to eliminate the folds.

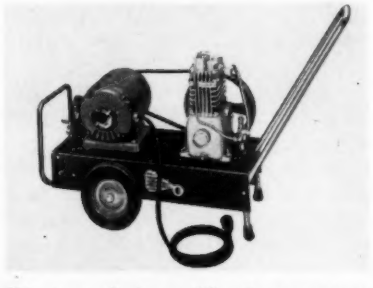
Mallis showed, in his talk on control of fabric pests, that 3% malathion, 6% DDT, and 0.5% Diazinon, are the most effective killers when sprayed on larvae of black carpet beetles. Dieldrin was at the bottom of the list. However, in a dye bath, Mallis said dieldrin is extremely effective as a moth proofer, in very small dosages.

In another set of figures, Mallis showed that German cockroaches resistant to chlordane are resistant to pyrethrins as well. It was 7-fold in the Sharon Strain, he said.

Two Penn State staffmen were featured speakers at the 3-day meet. Dr. Wayne Boyle spoke on fabric pests and provided damage specimens. Dr. Robert Snetzinger talked on clover mite biology while PCO Katz covered the chemical control of these pests.

Speaking on the business aspects of resistance, New Jersey PCO, Edwin J. Sameth, past NPCA president, predicted a period of economic adjustment for the pest control industry in the near future. "For the first time in history," he said, "we have more people in service industries than in production industries. With unfavorable import-export balances and shrinking markets, service industries will have to increase their efficiency just to break even. Resistance and other factors have increased costs, but increased compensation is not unlikely," Sameth observed.

During the business meeting, members of the Western Division joined delegates from the Eastern Division of the industry in the state to elect Harry Katz president of the Pennsylvania Pest Control Association. Katz, who runs Elco Manufacturing Co. in Pittsburgh, was also recently elected to head the Western Division of the group. Other state-wide officers picked at the State College meeting are, for vice-president, Alex Ehrlich; for secretary, John Becker; and for treasurer, Dale Fleming, D. M. Fleming Co., Philadelphia.



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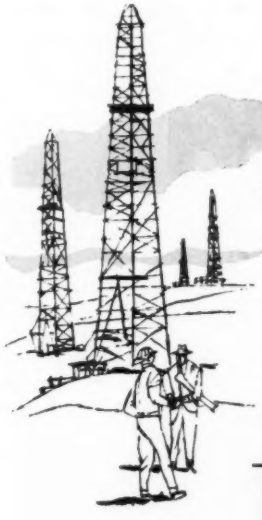

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Canada PCOs Meet April 24, 25

Canada Department of Agriculture's new K. W. Neatby Building in Ottawa, Ontario, that contains some 125 laboratories, will be site of the 19th Annual Canadian Pest Control Operators Conference, April 24 and 25.

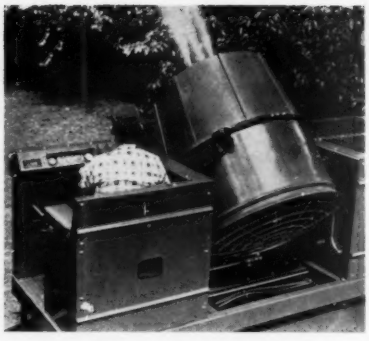
Convention delegates will explore newer pest control chemicals and rodenticides and will be updated on modern small business aids. Registration fee for the affair is $10 which can be sent in advance to Mr. C. S. Burton, P.O. Box 421, Kingston, Ontario.

Convention headquarters will be at the Bruce MacDonald Motor Hotel where reservations can be made by contacting the hotel directly.

Bean Adds 2 Sprayer Models

Two new models have been added to the line of Rotomist shade tree sprayers manufactured by John Bean Division of the Food Machinery & Chemical Corp.

Model 301 reportedly covers 50 to 100% more trees per day than the smaller Rotomist models. It



Bean's New Rotomist Model 301 tree sprayer.

delivers spray at 20 gpm with 300 lbs. pressure through 3 micromist nozzles located directly in the air stream.

Model 91 is equipped with a John Bean Royalette pump with capacity of 10 gpm at 400 lbs. pressure. It uses a 27" axial flow fan driven by multiple V-belts to the engine directly through a right angle gear transmission.

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Notebook

TIPS AND IDEAS FROM THE FIELD

Indoor Mosquitoes

by A. PESCOP

Mosquito-proof window and door screens do not always guarantee a home will be free of the pesty insects. This we learned during a job last summer after a customer called us in disgust and asked us to help him get rid of the mosquitoes that were keeping him up half the night.

He was disgusted because he had just finished paying for aluminum screening for all the windows and doors of his home; screens he made sure were small enough to keep mosquitoes out.

For a while he was happy. It was the mosquito season and he had not been bothered. But suddenly he began spotting the siphon-snouted insects flying around his home. There were enough of them to suspect that they were not stragglers that might have sneaked through a door as someone was entering or leaving, so he checked all his new screens for holes. Then he called us.

Our first job was to aerosol the rooms for existing mosquitoes. Then we set out to discover where these pests were coming from. We spent some time outside the house looking for pools of stagnant water in which they might have been breeding, but found nothing. Our search led us back inside the house where we finally spotted the trouble.

In the basement fruit cellar, that wasn't as cool as it should have been, we found a pan of water, almost half evaporated, which had been a drinking trough for the family's pet cat. It had held about two quarts of water when full. The cat had been hit by a car and killed about a week prior to our visit, but none of the family remembered to empty the pan of water. From evidence inside and around the water can, we were able to determine that this was where the mosquitoes had been breeding.

If you are ever called on a home mosquito job, check the inside for places where water sits for 3 to 5 days; mosquitoes are likely to be breeding there.

Fight pests safely, comfortably, with MSA protective equipment

M-S-A® INDUSTRIAL GAS MASK

Guards against the hazards of organic insecticides and other highly toxic pest controls. Single lens CLEAR-VUE* Facepiece gives complete facial protection. Gas-tight seal.

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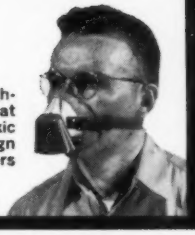
M-S-A® HCN DETECTOR

Easy-to-use, accurate instrument for "sniffing out" HCN in any suspected area. Registers amount of HCN in air in two minutes.

M-S-A® DUSTFOE® RESPIRATOR

Comfortable, lightweight breathing protection against dusts that are not significantly more toxic than lead. Streamlined design eliminates blind spots. Workers wear this one.



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Safeguards operators against Hydrocyanic Acid Gas in areas where enough air is present to support life. Complete range of individual canisters and masks available for all other vapors, dusts, fumes.

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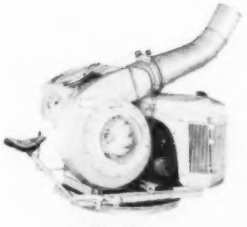
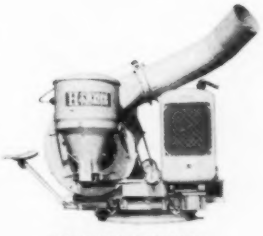


SPRAYER



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Here's the one unit that gives you just what you want, when you want it. The famous Hardie Sprayer. It embodies the recommendations of State & Federal authorities; tree service organizations and foresters who sought in one unit a high velocity, ample air volume sprayer for any type job, along with low price.

With its high velocity — 150 MPH — it is of special value in the treatment of trees infested with the bark beetle. Public Health officials also use the Hardie for mosquito control. With the attachment of the Hardie Duster, you then can use either spray materials, or dust or granular materials.

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WILKES-BARRE, PENNSYLVANIA

Infestation Report

Contains pertinent portions of the Department of Agriculture's Cooperative Economic Insect Report, material from university entomology departments and reports from readers. PCOs noticing infestations in their own areas are urged to communicate with *Pest Control* so their information may be added to this infestation report.

IMPORTED FIRE ANT

(*Solenopsis saevissima richteri*)

Mississippi: Infestation found at Vicksburg confirmed during December. First record in Warren County. **North Carolina:** Two minor infestations found in Brunswick County, one two miles from nearest known infestation.

PHARAOH ANT

(*Monomorium pharaonis*)

Texas: Many residents in Brazos County concerned with infestations in homes.

BROWN SPIDER BEETLE

(*Supella clavipes*)

California: Heavy population in a residence in Chico, Butte County.

DRUGSTORE BEETLE

(*Stegobium paniceum*)

Utah: Numerous in spice in Logan.

KHAPRA BEETLE

(*Trogoderma granarium*)

Arizona: Two infestations found in Maricopa County, one new infestation discovered 2 miles south of Camp Verde in Yavapai County. Two others treated in Yuma.

RED FLOUR BEETLE

(*Tribolium castaneum*)

Arizona: Heavy populations present in areas of grain storage throughout the state.

OLD HOUSE BORER

(*Hylotrupes bajulus*)

Maryland: Damage to structural wood noted in homes at Baltimore and College Park.

PUSS CATERPILLAR

(*Megalopyge opercularis*)

North Carolina: Child playing around tree where caterpillars and cocoons were found required doctor's attention in Yadkin County.

COCKROACHES

Maryland: Brown-banded roaches (*Supella supellectilium*) infesting homes at Baltimore, Catonsville and Landover Hills. **New Mexico:** A problem in homes in Albuquerque area. **North Carolina:** *Leurolestes pallidus* taken in a home in Forsyth County in both adult and nymphal stages. A new record for the state. **Utah:** Brown-banded roaches difficult to eliminate from a home at Vernal, Uintah County.

EARWIGS

Texas: Residents in many areas still concerned. Latest report of infestations comes from Port Arthur. Species probably *Labidura riparia.*

STICKTIGHT FLEA

(*Echidnophaga gallinacea*)

California: Light infestation on a dog in Escondido, San Diego County.

A LEAFHOPPER

(*Keonolla confluens*)

Washington: Large numbers of adults entering houses and causing annoyance in Yakima and Toppenish area.

CLOVER MITE

(*Bryobia praetiosa*)

California: Heavy adult populations invading a house in Calix, Santa Barbara County. **New Mexico:** Many homeowners at Raton, Colfax County, report this pest entering homes in extremely large numbers as weather became warm and then turned cold again. **North Carolina:** Numerous outside doors and windows of homes in Iredell County. **Oklahoma:** Causing annoyance in some homes in the central and east central area of the state.

MUSHROOM MITE

(*Tyrophagus putrescentiae*)

Texas: Heavy in kitchen cabinet of private home in Austin. No dermatitis has been associated with the mite by any member of the household.

TROPICAL RAT MITE

(*Ornithonyssus bacoti*)

Texas: Found infesting a home in Lee County. Children bitten underneath clothing on tender areas of body.

MOSQUITOES

California: Heavy rains apparently activated hibernating females which have become annoying to residents along the lower Sacramento River. Particularly noticeable in Sacramento area the past two weeks. **Oklahoma:** Adults of *Psorophora* sp. active in Stillwater area. **Texas:** January collections in Jefferson County more numerous than in Jan. 1960. Predominant species was *Culex* spp. Significant numbers of *C. nigripalpus, C. fatigans,* and *Culiseta inornata* also taken.

INDIAN MEAL MOTH

(*Plodia interpunctella*)

North Dakota: Light larval infestations of this species and *Ephestia* sp. observed in several commercial grain storage units in eastern area. **Utah:** Outbreak in a grocery store at Logan caused much labor and some financial loss.

BROWN DOG TICK

(*Rhipicephalus sanguineus*)

Arizona: Heavy populations continue to be a problem to some central area homeowners. **Oklahoma:** Causing some concern in several homes, where pets were allowed inside, throughout central and north central areas. **Texas:** Moderate to heavy infestations on dogs in Brazos County with several reports of home infestations. Heavy invasions of this tick in lawns, on dogs, and in homes causing great concern among residents in Bryan-College Station area. **Washington:** An engourged female was collected in Spokane in January. This is a rare occurrence in the state.

ROCKY MOUNTAIN WOOD TICK

(*Dermacentor andersoni*)

Washington: Found in Steptoe Canyon, Whitman County, earliest activity record for this species in this area.

EASTERN SUBTERRANEAN TERMITE

(*Reticulitermes flavipes*)

Maryland: Winged forms noted in a home in Baltimore.

WASPS

(*Polistes* spp.)

Oklahoma: Becoming active in Stillwater area during periods of mild weather.

RICE WEEVIL

(*Sitophilus oryzae*)

Texas: Heavily infested stored ear corn in Tyler County.

Va. Mosquitomen Talk Algae

(*from page 64*)

sects Affecting Man and Animals Section. Dr. Fluno said of all the insecticides tested by the USDA, Dibrom appears to be the most promising. He told of another material which produced a residual of over a year, but because of its high toxicity, it is not expected to reach the market.

Training guides offered by the CDC, which include printed material, films, and training sessions, were described by Dr. Harry D. Pratt, chief of the CDC's Insect and Rodent Training Branch. He presented a film showing actual cases of encephalitis in children and horses.

The disease was further reviewed by Dr. Lyle E. Hagmann, Rutgers University entomologist, who told delegates a follow up report of the 1959 outbreak in New Jersey indicates that the disease is not as fatal as NJ officials had thought. He said many persons had contacted the disease during the outbreak and were able to fight it off without serious after effects.

A failure in a recent aerial application of granular paris green was explained by Harold Russell, special assistant in entomology and wood preservation for the Fifth Naval District, Norfolk, Va. He said the project failed because a commercial formulator had not added enough emulsifier to the material, which caused the paris green to stick to its vermiculite carrier and not float away after it hit water.

Other speakers were Paul C. Henderson, U.S. Public Health Service sanitary engineer, who told of the problems encountered in a mosquito control project in Cape Hatteras, N.C.; E. C. Meredith, director of Virginia Health Dept.'s Engineering Division, who reported that $750,000 was expended by his state for mosquito control in 1960; George Hackworth, supt., Tanners Creek Mosquito Control Commission, Norfolk, who gave a report on the American Mosquito Control Assn. meeting in California; and John T. Lamb, Jr., Virginia Health Dept. entomologist, who explained the conversion of Todd fog machines to propane fuel.

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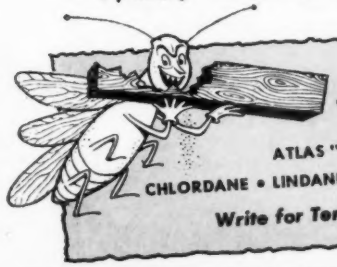
Kills all vegetation! Stops new growth! A combination of proven weed and grass killing chemicals. No mixing . . . the dry pellets are ready to apply with mechanical spreader or by hand. If you offer weed control service, you will want Chlorea Granular for its easy use, low dosage rate and powerful kill. Apply early for best results.

This small amount kills over 50 square feet of weeds and grass. . . . 400 pounds treats an acre.
LONG LASTING CONTROL OF ALL VEGETATION

FREE! ***SAMPLE AND ILLUSTRATED FOLDER***



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Write for Termite Control Circular

CHIPMAN CHEMICAL COMPANY
Dept. 7, Bound Brook, N. J.

Management of Water

(*from page 38*)

and low areas must be built so they hold water continuously and have steep sides, *or* are ditched and made self-draining. Flotage is to be stranded by the spring surcharge and there must be a planned program for cyclical fluctuation and seasonal withdrawal of water from the reservoir.

Project Distribution System. Where there are problems of seepage, blocking of natural drains, and impounding waste water, main canals and laterals are to be built in impervious soil or are lined with tile. Drains need to be installed to prevent ponding, and borrow areas are constructed to be self-draining. Delivery schedules must provide adequate, but not excessive, water, and the distribution system must be periodically cleaned and maintained.

Irrigated Farms. Man-made, "on-field" mosquito-breeding problems will exist unless there is proper layout of the farm supply system, drainage system, and field layout. All surface-irrigated fields must be properly graded. Only the necessary amount of irrigation water should be used and an adequate drainage system must be provided to remove excess water.

Project Drainage System. Where "off-field" mosquito breeding may be a serious problem in roadside ditches, borrow pits, and wasteland, main drainage systems should be installed to remove waste and natural water in irrigated and non-irrigable land. Drainage ditches need to be built and maintained to prevent ponding in canals, but the ditches should be constructed so there will be no ponding outside the canals due to seepage or improper construction of spoil banks. Naturally all drainage systems must be periodically cleaned and maintained.

Proper drainage and the maintenance of constant water flow are keys to good water management.

Ethylene dibromide and methyl bromide are combined in Hot Spot Fumigant developed by Ferguson Fumigants, Inc., P.O. Box 5868, Ferguson 35, Mo. The patented fumigant mixture is applied to grain through a ¼ inch I.D. galvanized pipe probe which is inserted into the grain's hot spot. A brochure explaining the new insect killer can be obtained free from the company.

Hub States Has New Catalog

A new 56-page illustrated catalog of pesticides, suggesting formulations and applications of insecticides, rodenticides, and weed killers, is being offered free by Hub States Chemical & Equipment Co., 1255 N. Windsor St., Indianapolis, Ind.

ASS Offers Drill Bulletin

"How to Choose Masonry Drills and Drilling Equipment," is a two-page bulletin prepared by Associated Sales & Supply Co. being offered free of charge to PCOs who write the company at 5137 Southwest Ave., St. Louis, Mo.

SMO-CLOUD BUG KILLER

Registered with the U. S. Dept. of Agriculture

1 doz. 2 oz. cans **$7.80**

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NEW JERSEY MOSQUITO LIGHT TRAP

is necessary for Your Mosquito Control Program

- To Determine Species
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- To Evaluate the Effectiveness of Your Control Program
- Make the Public Aware of Your Mosquito Control Work

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. . . the New Jersey Mosquito Light Trap has been the standard equipment for sampling mosquito species and densities. Thousands of our traps are in use by the government, military, municipal and private pest control organizations throughout the world.

Models available for 110 Volt operation with or without automatic time switch. Also 6 or 12 Volt models for battery operation. Prices and literature on request.

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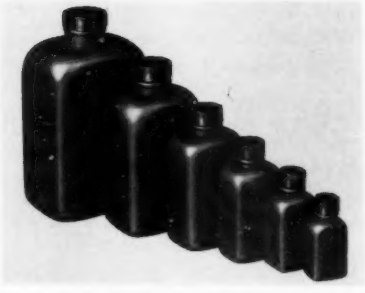
OLD FREEHOLD ROAD TOMS RIVER, NEW JERSEY



Rectangular polyethylene bottles designed to save shelf space for chemical storage, come in sizes ranging from 1 ounce to 32 ounces. Molded in amber or natural linear polyethylene as a standard item, the lightweight, unbreakable bottles are provided in any color upon request. For complete information and a free sample write to the manufacturer, Olympic Plastics Co., Inc., 3471 S. La Cienega Blvd., Los Angeles 16, Calif.

Millers Meet May 22-25

The Association of Operative Millers will hold its 65th Annual Technical Conference and Trade Show May 22-25 at the Pick-Nicollet Hotel, Minneapolis, Minn., its officers announced.

More than 100 exhibition booths are expected to be set up to display equipment and supplies for the grain industry.

Calendar

Washington Pest Control Assn., Monthly Meeting. 4904 Wisconsin Ave., N.W., Washington, D.C. April 17, 8 p.m.

New Jersey Pest Control Assn., Monthly Meeting. Rutgers University, New Brunswick. April 19, 8 p.m.

Maryland Pest Control Assn., Monthly Meeting. Lord Baltimore Hotel, Baltimore. April 20, 6:30 p.m.

Oklahoma Pest Control Assn., Monthly Meeting. Howard Johnston's Restaurant, Stroud. April 21, 6:30 p.m.

Pest Control Assn. of South Florida, Monthly Meeting. Lindsey Hopkins Vocational School, 1410 N.E. 2nd Ave., Miami. April 24, 6:45 p.m.

Canadian Pest Control Operators Assn. Annual Conference. K.C. Neatby Building, Experimental Farm, Ottawa, Ontario. April 24, 25.

Hawaiian Pest Control Assn., Monthly Meeting. Evergreen Restaurant, Honolulu. April 25, 7 p.m.

Chemical Specialties Manufacturers Assn. 47th Mid-year Meeting. Drake Hotel, Chicago, Ill. May 15-17.

Association of Operative Millers. 65th Annual Technical Conference & Trade Show. Pick-Nicolette Hotel, Minneapolis, Minn. May 22-25.

Florida Pest Control Assn. Annual Convention. Holiday Inn, Palm Beach. June 23, 24.

Ohio Pest Control Assn., Mid-summer Meeting. Midway Motel, Pearl Rd., Cleveland. Aug. 3-5.

Tri-State (N.C., S.C., Ga.) Mid Summer Convention, Grove Park Inn., Asheville, N. Caro. Aug. 3-5.

Iowa Pest Control Assn., Fall Meeting. Marshalltown. Sept. 28, 29.

Geigy Has Weed Control Booklet

"Preventive Weed Control for Industry," a 12-page booklet describing Geigy Agricultural Chemical's herbicides, Simazine and Atrazine, and stressing an around the calendar weed control program, is available without cost from the company.

Included in this illustrated, full-color brochure is a list and pictures of some 87 weeds that can be controlled by the two weed killing materials. To obtain a copy write Geigy Agricultural Chemicals, P.O. Box 430, Yonkers, N.Y.

Purdue Frosh Wins Scholarship

Gary Buckingham, of LaPorte, Ind., a Purdue U. freshman entomology student was chosen this year's recipient of the C. C. Alexander memorial entomology scholarship. The $400 award was presented to the youth by V. C. Freeman, associate dean of Purdue's Agriculture School, at a recent Agricultural Pesticide Conference.

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Legislation Affecting PCOs

Florida has *pending* legislation proposing to revamp the Florida Structural Pest Control Commission and to reduce the present three-year training period required before a person is licensed as a pest control operator to 1½ years. Under the proposal the five-man commission would be made up of two PCOs, and one entomologist each from the State Board of Health, University of Florida, and the State Agricultural Dept. instead of all PCOs as it is now set up.

Idaho has *pending* legislation, House Bill No. 218, which would enact the Economic Poison Act of 1961 governing distribution, sale, or transportation of adulterated or misbranded insecticides, fungicides, rodenticides, defoliants, desiccants, plant regulators, nematocides, and other economic poisons. Under the proposal these poisons would be registered and examined by the commissioner of agriculture. It would also require that all economic poisons be labeled and stamped with the date on which they were packaged and sealed.

Indiana has *pending* legislation intended to establish a board of registration for professional sanitarians. Under this proposal a "professional sanitarian" is defined as a person who is skilled in the science of public health and in sanitary science and who practices this profession to improve hygienic conditions of man's surroundings.

Massachusetts has *pending* legislation, House Bill No. 307, proposing the regulation of insecticide, pesticide, rodenticide, and herbicide spraying. This bill was introduced on petition of the Massachusetts Farm Bureau Federation, Inc. and was referred to the Public Health Committee.

Also *pending* are House Bill No. 135, concerning the establishment within the Department of Agriculture, of a division of Insect Pest Control; House Bill No. 1693, calling for insecticides, pesticides, rodenticides, herbicides and fertilizers to be tested and approved before they may be used on edible fruits and vegetables; and House Bill No. 308, which would allow the public health commissioner to set up special areas or zones where use of herbicides and insecticides would be restricted.

Nebraska has *pending* legislation, House Bill No. 457, proposing the Department of Agriculture and Inspection adopt a set of rules and regulations to control agricultural chemicals. Sale, storage, and application of chemicals for farm use would be regulated by the department under this proposal.

Oregon has *pending* legislation, House Bill No. 1391, which proposes use restrictions of certain herbicides within the limits of any incorporated city or town. The intent of this bill is to define "high-volatile, low-volatile, and non-volatile" herbicides and to tighten control of such materials.

West Virginia has *pending* legislation concerning registration, examination and control of economic poisons which calls for a $10 registration fee for the first 20 economic poisons registered and $5 for each additional label registered.

For more details on these pieces of legislation, contact the Legislatures of the states involved.

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2. CLUTCH PULLEY on motor shaft permits motor to start before centrifugally engaging pump.

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4. HAND WHEEL PRESSURE ADJUSTMENT in a return line system which provides agitation of chemical.

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6. COMPLETE, AS PICTURED, with pressure gauge, GunJet valve, special 4 gal. per minute nozzle, adapter, 18" curved aluminum extension, 3 Teejet nozzles, and 100 ft. ⅜" i.d. chemical & oil resistant hose with quick couplers.

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FUMO-KILL is truly the modern method of insect extermination. Light match to contents in can, will produce fumes — NO FLAME. Non-hazardous. This amazing FUMO-KILL insecticide has been tested, and found effective against most types of household pests.

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EASY TO USE: Requires no Special Equipment.

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EFFECTIVE TO USE — Follow instructions on can for best results. This Amazing FUMO-KILL insecticide is by all qualifications, a leader in its field.

FUMO-KILL can be obtained in 2 oz. (enough for up to 6,000 cubic feet)—4 oz. and 1 lb. cans.

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Drip-free operation since shut-off needle extends through extension to orifice tip.
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For permanent installation in plants. Connect to air line to operate. Plastic bottle holds chemical. Stainless steel nozzle in two or four tip designs. Single unit covers thousands of cubic feet.
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Portable for spraying chlorine solutions and related chemicals. Connect to air line for operation.

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When answering ads where box number only is given, please address as follows: Box number, c/o Pest Control, 1900 Euclid Avenue, Cleveland 15, Ohio.

Rates: "Position Wanted" 5c per word, minimum $2.00. All other classifications, 10c per word, minimum $2.00. All classified ads must be received by Publisher the 10th of the month preceding publication date and be accompanied by cash or money order covering full payment.

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THIRTEEN YEARS Experience. Pest control and termites, including branch office and divisional management. Willing to relocate for position of responsibility. Write Box 588, Pest Control magazine.

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HELP WANTED

EXECUTIVE MANAGER for pest control, fumigation and chemical company in southern California. Salary may run into five figures. Also opportunity to buy shares in corporation if desired. Write Box 587, Pest Control magazine.

FOOD & DRUG Inspector. We are sanitation consultants engaged in the business of making on the job inspections of all types of food plants, sampling foods for analysis, and generally operating for the protection of management. If you are qualified by experience to make physical inspections to a diversified food industry through past or present employment or have been employed by the U.S. Food & Drug Administration and are looking toward private industry for an opportunity, send full resume, education, and recent photo. Location, eastern U.S. Interviews arranged at no expense. Reply to Box 586, Pest Control magazine.

RAPID EXPANSION PROGRAM in Midwest enables us to offer qualified servicemen, salesmen and managers guaranteed salary and commission; Opportunity for advancement; permanent, year 'round employment; paid vacations, income when ill; outstanding fringe benefits including profit sharing, retirement (pension) plan; medical and surgical, hospitalization insurance, etc. Company pays all premiums. All replies held strictly confidential. Arwell, Inc., Waukegan, Illinois.

FOR SALE

TERMITE DETECTOR, used once, like new (except batteries), half price, $93.00. Ack Ack Exterminating Co., 402 Crawford St., Portsmouth, Va.

CALIFORNIA PEST Control business (eight various divisions). Originally established in 1934. Five trained employees, two state licensed, three over 15 years experience. Located center growing city near Los Angeles, over one million people, radius less than 10 miles. Five year lease with renewal present main street location. $10,000 will handle with good credit-terms. Retirement reason for selling. Write Box 581, Pest Control magazine.

WANTED TO BUY

FOR A NEW YORK City operator who may be overworked or looking toward retirement. Satisfactory terms for an outright sale or an agreement for a secured income can be arranged, based on partial or complete retirement. Excellent references. Replies in strictest confidence. Box 584, Pest Control magazine.

WANTED— RED SQUILL, powder or extract. Advise potency and condition. Write Eaton & Co., 1106 Lakeview Rd., Cleveland 8, Ohio.

WANTED TO BUY pest control firm or interest in firm in the South or preferably in the Southwest. Have college training and 15 years experience. Box 578, Pest Control magazine.

PEST CONTROL BUSINESS in New York State. Give Details and Price. Replies Confidential. Box 582, Pest Control magazine.

Dow Opens Texas Service Unit

A new chemicals technical service and development facility has been opened in Freeport, Texas by the Dow Chemical Company.

Called Technical Service and Development-South, the service unit will house an extension of operations performed at the department and company headquarters in Midland, Mich. A. J. Pastor, formerly a section head at TS&D headquarters in Midland, is supervisor.

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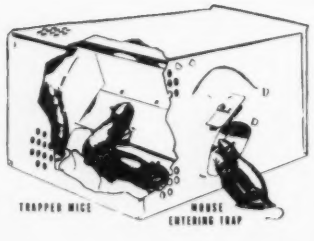
KETCH-ALL The *BETTER* Mouse Trap



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Catches Up to 15 Mice at a Setting. *Guaranteed*

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Catches mice when other traps and poison fail

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WIRE WORMS • WHITE FRINGED BEETLE LARVAE
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FIRE CRACKER soil insect killer is in granular form. . .more convenient and efficient. FIRE CRACKER granules deliver the poison in sufficient strength to give QUICK KILLS and in the correct place for maximum results.

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AVAILABLE AT YOUR MISSION BRAND CHEMICALS DEALER

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RAT CAFETERIA KILLS RATS!

Feeds 1 Full Quart Of Liquid Bait And More Than 6 Pounds Of Dry Bait

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SIZE 7 3/4 x 13 x 13

Today's largest-selling bait station. Approved by health authorities everywhere. Fabricated of heavy galvanized steel. Many report over 5 years of continuous use. No identification. Imprint your name.

Sample Cafeteria $3.00; Lots of 12, $2.25 ea. Lots of 48, $2.10 ea. Lots of 102, $1.95 ea. All prices F.O.B. Madison, Wis.

NESTED DESIGN SAVES YOU MONEY
New, slanted-side design nests 6 units to a carton. Saves 50% on freight, 50% on storage!
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UNI-VAP INSECTICIDE VAPORIZERS

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Perform Better
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Muscatine, Iowa

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Pestales

Swell trip. **Florida PCO Pete Clements, chairman of the 1961 NPCA Convention, had to cut short his trip to the Southern PCO Conference in Jackson, Miss. He noticed that his old friends shied away from him and even accused him of getting a little portly. These strange reactions by his friends and the recollection that he hadn't been feeling too well just prior to the trip, made him finally realize that he had contacted mumps. Rather than being quarantined in Jackson, Pete immediately flew back to his Ft. Lauderdale home. For a few days Pete was literally swell-headed, low down, like around the jowls.**

Poison for one; food for another: We wonder about a recent USDA discovery that ordinary sugar mixed into the soil acts as an effective killer of nematodes. It is recommended that "tons of sugar" per acre are required to do the job and this, the USDA admits, is "much too expensive." You can say that once more. It'd be expensive for homeowners, too, if the glucose killing stuff were spread over their lawns. Or do sweet-eating ant jobs come cheap these days?

* * *

Rockefeller's Choice. **Chester Schwimmer, president of Fumex Sanitation, Inc., Jamaica, N.Y. is Gov. Nelson Rockefeller's choice to fill a position on the Interstate Sanitation Commission. Active in many civic and religious groups, Schwimmer also won the approval of the appointment from the state senate.**

* * *

Who needs advice. In the Faeroe Islands, located between Sweden and Iceland, government officials recently appointed a "public rat advisor" to prescribe measures to end a plague of egg-eating brown rats that pose a threat to the island's bird life. And that's no yoke.

* * *

Honored by Jaycees. **Named as one of four outstanding men in the state by the Alabama Junior Chamber of Commerce recently was John R. Cook, owner of the North Alabama Termite Co., and Cook's Pest Control, in Decatur. He was chosen for his contribution to civic events and for his work in the Jaycees. Nice going, John.**

* * *

Canine, feline decline. During a recent program to eradicate a plague of field mice in Niigata, Japan, a group of farmers spread poisoned bread in the area. Results: 30 dogs and 20 cats dead, with no indications of dead field mice. The farmers seemed to have achieved pretty good results, but with the wrong animals.

* * *

New head man. **New general manager for the Arizona Exterminating Co., Phoenix, is Arthur N. Schroeder, a six year veteran of the company who once operated his own pest control business in Louisville, Kentucky. Hope all those baseball teams that have been training in the Phoenix area didn't leave Art with too many bat infestations.**

* * *

Bye, bye blackbirds, et al. Aldermen of St. Louis, Mo., finally became so disgusted with starling, pigeon, and sparrow filth, that they amended an old law and lifted the veil of protection from the bird pests. These birds can now legally be killed by average citizens, but in a humane manner. All they have to do is catch them.

* * *

Mosquitomen honored. **Members of the Virginia Mosquito Control Association at their annual meeting recently cited Dr. William E. Bickley, Maryland U.'s head entomologist and president of the American Mosquito Control Association, and Robert L. Vannote, national advisor to the AMCA, for their contributions to mosquito work in Virginia. Neither man is a Virginian, but the results of their work are harvested in many areas throughout the country.**

* * *

Executive house mouse. Ohio's Gov. Michael DiSalle called a meeting of the bureaucrats recently after he spotted a little house mouse staring him in the eye at the executive mansion. "He has to go," the governor announced and placed the job personally in the hands of Robert Terhune, state agriculture director and brains behind the state's rodent control program. The director promised to throw his entire department into the campaign against the diminutive pest. Latest odds give the mouse a very tiny chance to get out of politics safely.

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A complete line, with the right unit to meet YOUR requirements! A trial will convince you! Used by many P.C.O.'s.

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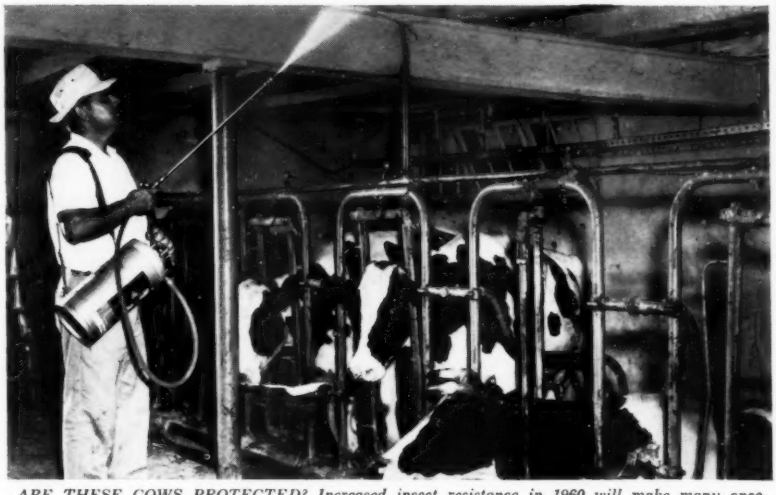
FLY CONTROL MEANS BETTER MILK



ARE THESE COWS PROTECTED? Increased insect resistance in 1960 will make many once-successful insecticide formulations obsolete, emphasize researchers at Fairfield Chemicals, Food Machinery and Chemical Corp. Use of maximum-effectiveness insecticides containing Pyrenone assure animals of complete protection and prevent loss of farm income due to drop in milk quality.

Flies "Take Off" When Up Against Pyrenone and Crag Fly Repellent

Flies are finding it more dangerous lately to attack grazing animals. Not only is it proving more uncomfortable for the flies, but it's becoming downright fatal.

Farm use of insecticide and repellent combinations like Pyrenone* and Crag Fly Repellent† afford additional protection to grazing animals...protection that kills flies on contact and repels future attacks for several days.

Field tests show that sprays which depend primarily on repellents have limited value. Flies, gnats and mosquitoes stay in the area, bothering animals and attacking non-treated stock. When grazing cattle are annoyed by insects, quantity and quality of milk yields suffer.

To the farmer, milk loss means money down the drain, a sharp drop in profits. When cattle are busy battling biting insects they haven't time to graze properly. They take in less food and lose blood, energy and weight.

Versatile Pyrenone and Crag Fly Repellent combinations, available as oil sprays and water emulsions, are the answer. Highly effective, they are accepted under the Miller Bill on a "non-residue" basis. No trace of these approved formulations appears in milk or meat of treated animals. They assure maximum protection for greater milk output the year 'round.

*U.S. Pat. Off. FMC †U.S. Pat. Off. U.C.C.

Copies of the following booklets may be obtained from local Fairfield representatives or by writing to Fairfield Chemicals, Food Machinery and Chemical Corporation, 441 Lexington Avenue, New York 17, New York.

☐ TECHNICAL BULLETIN No. F-1 — Free bulletin describing Pyrenone and Crag Fly Repellent formulations.

☐ FAIRFIELD FACTS FINDER—a new, 20-page comprehensive guide and unique, revolving calculator covering Pyrenone base formulations for dairy, garden, home and industrial sprays, aerosols and powders as well as an index to insects and pests. Price—$1.00.

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Pyrenone Formulations Keep Cows Contented As Flies Get Tougher

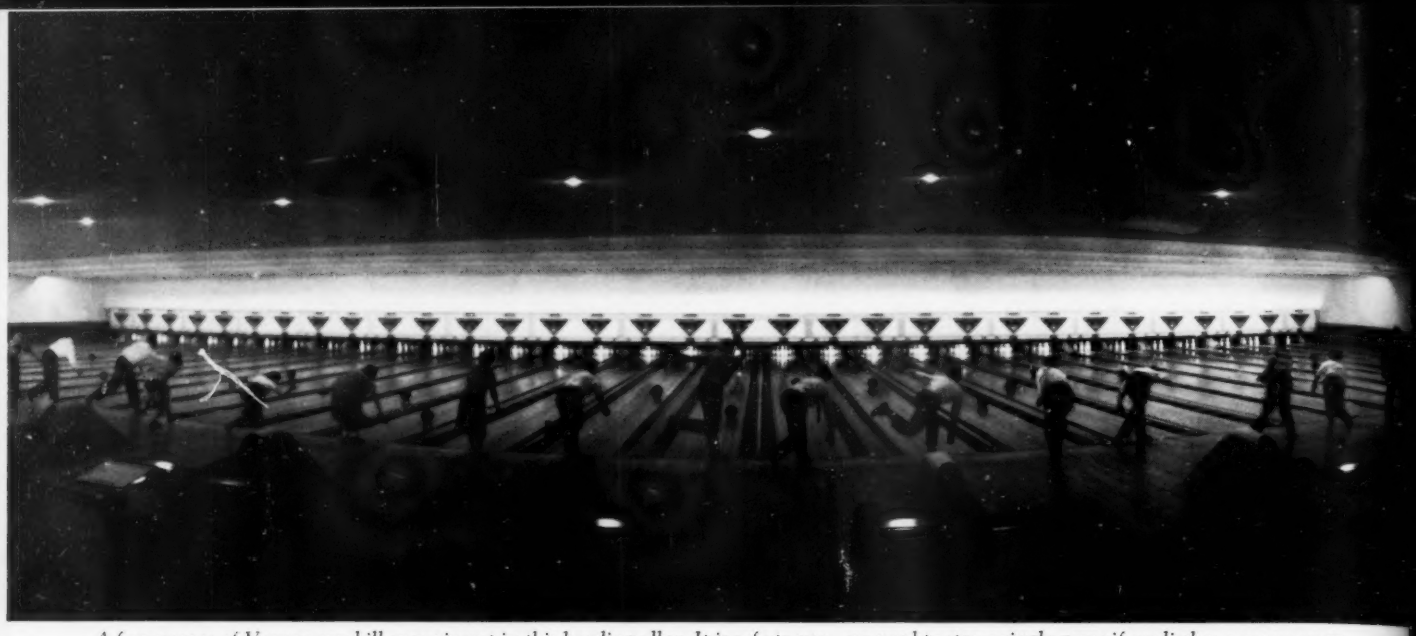
Formulators whose insecticides offer Pyrenone's maximum protection will get a greater share of farm business during 1960. Field tests prove that maximum control of biting flies means better milk—hence, more money for the farmer.

With flies becoming harder to kill every year, dairymen can't risk insecticides that lose their "punch." Entomologists reveal that in some areas last year, they changed formulations two and three times to maintain fly control. Non-toxic Pyrenone appeared in virtually every final successful insecticide.

Milk quality suffers when biting fly control is below maximum. In Illinois, during a May-June span, twelve herds not protected by an effective insecticide lost 13 to 14.8 percent in butterfat. A 1-percent piperonyl butoxide and 0.1 percent pyrethrins Pyrenone emulsion used twice a week in amounts of 10 to 15 ounces per cow brought butterfat back to normal in a month.

Effective Pyrenone formulations for sprays, emulsions, powders, etc., are included in a free booklet, "Dairy, Livestock and Cattle Sprays, and Dusts," available upon request.

☐ DAIRY SPRAYS—Free booklet describing Pyrenone formulations for sprays, emulsifiable concentrates, wettable powders, fogging sprays. Pyrenone and repellents, Pyrenone aerosols, cow bombs.



A few ounces of Vapona can kill every insect in this bowling alley. It is safe to use—no need to stop a single game if applied as a coarse spray.

ANNOUNCEMENT:

A few ounces of remarkable new Vapona® Insecticide can eliminate every major crawling and flying insect in this 265,320 cubic foot bowling alley

Vapona is a new phosphate insecticide. It is highly effective against a wide range of public health insects. Very low dosages kill even resistant strains.

Read how new Vapona can be applied safely using standard equipment and techniques. And how you can start using it for more effective and economical control of insects.

NEW Vapona works differently than other insecticides.

In addition to killing insects on contact, it has a vaporizing effect. Insects can no longer avoid being killed by hiding in cracks, crevices and other hard to get at places.

Vapona knocks down and kills insects within a few minutes of application. Then, it disappears rapidly with ordinary ventilation.

Low cost

Vapona is applied at extremely low dosage rates. As little as ½ to 2 milligrams per cubic foot controls the toughest insects.

Because Vapona kills at such low dosage rates it is economical. It can do a better job of controlling insects for half the cost of many other insecticides.

Safe to use

Vapona offers safety in use. When applied as a coarse wet spray at recommended dosages, there is no need to wear a respirator. It is not necessary to evacuate inhabitants of homes, restaurants, stores and other public places while application is being made.

When fogging or mist spraying indoors, the building should be evacuated and the applicator should wear a respirator. Buildings should be ventilated before people are allowed to re-enter.

Vapona can be applied with all standard application equipment.

Available in 4 forms

Vapona Insecticide is available in emulsible concentrates and concentrated solutions for further dilution and in liquid and dry baits. Ask your regular supplier for Vapona Insecticide.

For more information, write: Shell Chemical Company, Agricultural Chemicals Division, 110 West 51st Street, New York 20, N. Y.

Control all these insects with Vapona

1. Flies	**9. Silverfish**
2. Mosquitoes	**10. Fleas**
3. Wasps	**11. Fruit flies**
4. Flying moths	**12. Phorid flies**
5. Gnats	**13. Cigarette beetles**
6. Cockroaches	**14. Tobacco moths**
7. Ants	**15. Other small flying insects**
8. Spiders	

Shell Chemical Company

SHELL

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